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Will the Shipping Board Explain?

SOMETHING more than the brief announcement of the proposed construction of 1000-ft. steamships, noted in the news pages of this issue, should be made by the Shipping Board. The mammoth and ornate passenger liner costs a lot of money, some of which in the past has been written off as advertising for the line which builds it. Who is going to operate these new Government ships after they are built? What is their advantage to the American merchant marine over the three or four passenger steamers of moderate size which the cost of each represents? These are questions the Government should answer before going further in the project. As for the Montauk Point terminal scheme, it seems that it must come before the public about every so often. Today, as nearly thirty years ago when it was first proposed, it needs much defending. Obviously, it is not cheaper to carry freight by rail down Long Island than by steamer alongside Long Island, and if passenger and mail speed is the thing desired, why not Boston as a fast-line terminal? If cheaper freight handling is wanted, why not better terminals in New York harbor, where there is still room to dock a number of 1000-ft. vessels with no interference and to put the transatlantic passenger down directly where he wants to be—that is, in New York City?

Oriental Oils and Pacific Ports

TRADE in oriental vegetable oils is new in this country. A few years ago it was comparatively unknown; last year the port of Seattle alone handled 90,000,000 gal., and an article on another page makes it clear that every Pacific port is considering increased provision to take care of the new commodity. The highest form of engineering is here involved. Not only must the actual designing and building of a new type of port facility be carried out expeditiously, but port authorities must be led to see the great importance of the new import trade, which has virtues for the port an export business does not possess. Vegetable oils are used in the manufacture of soap, food products, explosives, paint oils and varnishes. In building up a trade in such oils there is necessarily built up an attraction to those industries which use them as a raw material. Thus, contrary to such an example as Galveston, with its export cotton trade which attracts no business to speak of, the import oil business may serve to build up the cities' industrial development. Furthermore, oil-unloading facilities may attract other freight. Most cargoes can be unloaded at any well equipped wharf, but if only certain locations have the facilities which the oil trade requires that trade is naturally diverted in that direction, taking with it perhaps even a greater tonnage of general freight. Engineers on the Pacific Coast have made a signal success of the oil-port business in the past two years. They should continue to press the advantage which that success has given them.

Indirect Income from Good Roads

WHILE the value of good roads to the public is very generally admitted, it is doubtful whether many people comprehend the magnitude of the benefits. The direct benefits due to greater ease of communication are understood by all, but the value in dollars and cents of the total saving in transportation costs on so comparatively small a unit as the ton-mile, is seldom realized. This saving is discussed in an article on p. 214, by John C. Veenhuyzen of Los Angeles, who calls it "operative income," and bases it upon the difference in transportation cost per ton-mile over improved and unimproved roads. Mr. Veenhuyzen's method of computation may be questioned, because he has used the total traffic on the improved road to figure his saving, while such an amount of traffic on the unimproved roads with which comparison is made would be impossible. However, when a road is improved, produce comes to market which otherwise never would have come, and a saving in transportation reacts to the benefit of the consumer in lower prices for farm and other products. That is, in every business investment—and roads should be classed as such—income develops only as the investment becomes effective. Furthermore, in this case, as in every other, it is necessary to ask, Will the business—the traffic—warrant the expenditure? On the basis of the figures presented it would seem that no community where a fair traffic can be expected can afford to leave its highways unimproved; in fact, with one-tenth the traffic, the roads described could be paid for in a four-year period. Such conditions indicate that the highest quality of surfacing ordinarily employed would be amply justified when its cost is balanced against a yearly income estimated in the form of saving to the community.

Engineers' Salaries and Small Dollars

ONE explanation of the present unrest among engineers is found in the diagrams on p. 182 of our last week's issue, illustrating the shrinkage in the purchasing power of the dollar. They show that an engineer in Washington who had a salary of $70 a month from 1895 to 1897 could buy as much with it as he could at the end of 1918 with $170 a month, and that an engineer now drawing $100 a month can buy only 57% as much with it as he could in 1910. Changed conditions have brought enough more dollars to trade-union men and to unskilled workers to make up much if not all of the shrinkage of the dollar in value, but the great majority of engineers who live on salaries are struggling to make both ends meet with about the same number of dollars

as before—or, to put it another way, with smaller dollars and few, if any, more of them. This does not come from intention to be unjust to the engineer. It comes from ignorance—or from ignoring what has taken place in the value of the dollar, and the extent to which this represents a condition of more or less permanence. In most industries salaries cut so small a figure compared with the cost of labor and materials that the salaried worker might readily be given the square deal in increase of pay. For instance, if the standard allowance for engineering and incidentals on large construction work, say 10% of the total of all the other elements of cost, will still be allowed today when the total cost may be nearly double what it would have been five years ago, the amount available for compensation of engineers will be ample to represent fully the changed value of the dollar.

Holding the Migratory Workman

THE migratory workman is the pest of the construction manager. He drifts into camp, and after a week or a month "rolls his blankets and moves on"—and unit labor costs go up another notch. Cost data and job analyses generally fail to record this item of expense, but it counts in the bidding prices, and no contractor professes to have any very clear idea how it can be eliminated. The "floater" shows only resentment toward obvious "welfare" service, and anything which smacks of paternalism arouses him to rage and radical utterance. Great interest, therefore, lies in the article on p. 213 in which W. C. Ruegnitz explains one of the methods by which he has been able to put at least a dragging anchor on the "floater" of the logging camps.

As Mr. Ruegnitz describes it, his task appears to have been very simple. What was done and how it was done are, however, only a part of the story; the manner of doing what was done is the other and greater part. Men were not coerced into acceptance of bed service; acceptance was not urged. Instead the attitude was, "Here is the service, with bath, beds, pillows, sheets, blankets all complete; if you didn't bring your blanket roll you might try it." One or two men did try it, and they told others braggingly of their better lodging. Others tried it, until now in this camp 90% of the workmen pay for bed service, and labor turnover has been greatly reduced. Briefly, the men were not educated but were led in a subtle way to educate themselves. In this method is the secret of success in stabilizing the migratory workman.

Naturally, bed service might not be expected to solve completely the problem of eliminating the floater. However, giving the men good beds might—and, as events proved, did—induce many of the floaters to stay on the job long enough for a start to be made in their further self-education. Now another step is being taken. The men are being encouraged to form clubs to manage their own bed and bunkhouse service, with the idea that they may develop interest in the camp and become permanent employees. By bringing in the family man and giving him a detached house the camp has been given an atmosphere of a permanent living place instead of that of a temporary lodging. Other methods are enumerated in the article. They are operating successfully. Mr. Ruegnitz would, we imagine, be the last to claim that he has by these methods eliminated the floater from his camp, but he may justly claim that in his camp the floater less often breaks his moorings and drifts away. And, what is extremely interesting, this has been accomplished with a reduction in cost of bunkhouse service to the employer.

Further Tests of Steel Columns

INTERRUPTED by the onset of war, investigation of column strength is likely to be resumed in the very near future. At the American Railway Engineering Association's meeting four months ago it was announced that a new series of tests of steel columns would probably be initiated during the current year. This announcement recalls not only the earlier tests of the association, a rather limited series, but also the great and costly set of tests carried out for a committee of the American Society of Civil Engineers.

New tests, it is obvious, should be planned from the vantage point of the best existing knowledge of column strength. It would be unfair to the intricacy and importance of the subject were further costly and tedious experimental work undertaken otherwise than with the aid of the information yielded by previous work. However, the data of the Civil Engineers' tests have not yet been subjected to critical scrutiny and analysis. In the hundreds of test sheets containing these data, much may lie concealed that would help in planning the new tests: Facts on column behavior as well as cautions with regard to methods of testing or preparing for tests. It would seem wise and prudent, therefore, to defer the inauguration of the proposed tests until the study and analysis now lacking can be made.

For the same reason, it is desirable that the data of the Civil Engineers' tests should without delay be placed in the hands of trained laboratory investigators for study. Moreover, a peculiar obligation rests on the engineering profession in this matter, as was pointed out in these columns two years ago. It arises from the fact that the cost of the tests was defrayed by the Government. The tests were extremely costly, and thus it happens that a large fund was virtually placed in trust with the engineering profession, to the end that construction might be made safer and more economical, for the good of the people. This trust will not be discharged until full study has been applied to the test data, and the work done has thereby been crystallized into fundamental engineering fact. Few engineers believe that the report of the Civil Engineers' committee contains the full net result of the test series. The committee's conclusions commanded so little confidence, in fact, that the representatives of the American Railway Engineering Association, in deciding upon working stresses for bridge members, declined to accept them and instead set up a quite different set of recommendations. The specific comments that have been made concerning the Civil Engineers' column-test report need not be repeated at this time, but those comments amply demonstrated that the report was not based on detail analysis of the test figures. If this be the case, even those who see great value in the report will concede that such analysis should be undertaken.

A serious difficulty in the matter is that professional engineering organization is not well prepared to furnish the tools and funds for the required study. Laboratory training and engineering skill jointly must be applied to the problem. Months of time will be required, which means money to finance the work. It is estimated by men skilled in research that twice as much time is re-

quired for studying and working up test data as for making the tests, and on this basis the several thousand hours consumed in testing the columns of the Civil Engineers' series must be followed by many months of painstaking study. With respect to both skill and funds, it is not easy to see how the conditions are to be met. But there is no doubt that methods will be found, or will be created, once the need for doing the work is clearly recognized.

For full appreciation of the case, it is to be remembered that the tests in question constitute one of the great engineering laboratory investigations in the records of the art. The work was carried on with great precision and in patient detail. But as the behavior of different grades of metal and of various kinds of column structure were involved, and such testing is highly delicate work at best, the gross results cannot be accepted as final without critical questioning. Are all the figures reliable? Have they such character that they can be directly compared? What is the relative significance of the readings of compression, set and lateral deflection? Did the tests produce any figures of value other than the gross ultimate-strength and yield-point data? Generally, what facts are disclosed by the tens of thousands of readings that were taken? Are special features of column behavior, such as the rotary buckling exhibited by certain of the members, important phases of the problem? Is the value of the group of results vitiated by the variation of the test-column material? There is no dearth of essential questions in the problem presented. And many, if not all of them, are likely to have bearing on the tests which the American Railway Engineering Association is preparing to undertake.

Thus, engineers of high prominence in the structural field assert, on the basis of what the Civil Engineers' test indicate, that it is not possible to secure steel uniform enough for consistent results in a long series of column tests. If this be true, and if present acceptance methods cannot be modified so as to assure test-material capable of giving more uniform results, there is no prospect that new tests would be other than a waste of effort.

But there can be no doubt that the proposed tests represent a sound and progressive purpose. They aim at the most important unsettled point in column practice; namely, safe and efficient details. The underlying idea thus is very different from that of the Civil Engineers' tests, which were concerned with solid columns and only solid columns abutting against flat bearings.

It is doubtful whether there has been any large uncertainty in recent years concerning the safety or economy of solid-section steel columns. The working stresses of current practice were known to be safe, yet at the same time high enough to leave little room for increase. Some engineers saw an opportunity for arriving at a better balance of safety as between long and short columns; that is, determining a better formula for working stresses, and the tests were undertaken with this in view. But the purpose failed, for the tests when completed were declared inadequate as a basis for a new column formula; the matter was compromised by using the tests for tentative conclusions as to columns of moderate length, and applying general engineering experience to longer columns. Inasmuch as the other question presented by solid columns, that of proper design of end connections, was elminated from the Civil Engineers' test series by using only square abutment ends, in all cases carefully dressed true, the tests were not adapted to give much aid to practice. Solid-section columns loaded by square abutments are rare; perhaps still more rare are columns loaded centrally and free from lateral forces. Very different is the case of the proposed A. R. E. A. tests. These, dealing with open-webbed or latticed columns, have immediate relation to the important subject of bridge members. They will throw light on serious questions concerning the most efficient way of joining the several parts of a column and of connecting it to its abutments.

The proposed tests therefore promise to increase our ability to utilize structural materials efficiently. Engineers will welcome the promise of securing further data on steel columns, tending toward maximum efficiency of construction. But if the new tests are begun before a thorough study of the prior series is carried out, an opportunity and an obligation will have been neglected.

Highway Engineering as a Science

HIGHWAY engineering has reached a stage where it should be developed as an exact science. The custom of laying out a road for line and grade, and then arbitrarily setting a slab thickness for its entire length without reference to the soil conditions is not logical. When loads were so light that to design for them would have given a crust so thin that it would not resist the climatic and other external forces acting on the road, such a procedure was permissible. With the advent of the motor truck, road slabs must be made heavier, and there is now an opportunity for scientific engineering ability in the design of a road.

True engineering includes not only making a structure strong enough, but also giving due regard to economy in the use of material. Many roads throughout the country have unnecessarily heavy sections, when the underlying soil conditions are considered, even taking into account the greatly increased weight of traffic. Other roads are too thin, at least in places, as is evidenced by breaking up under the increased weight of traffic. Where drainage is good, heavy motor traffic has been carried, during the past two years, over what are considered very cheaply constructed roads, such as water-bound and bituminous macadam. In places these went to pieces, but in long stretches they were adequate, showing practically no strain.

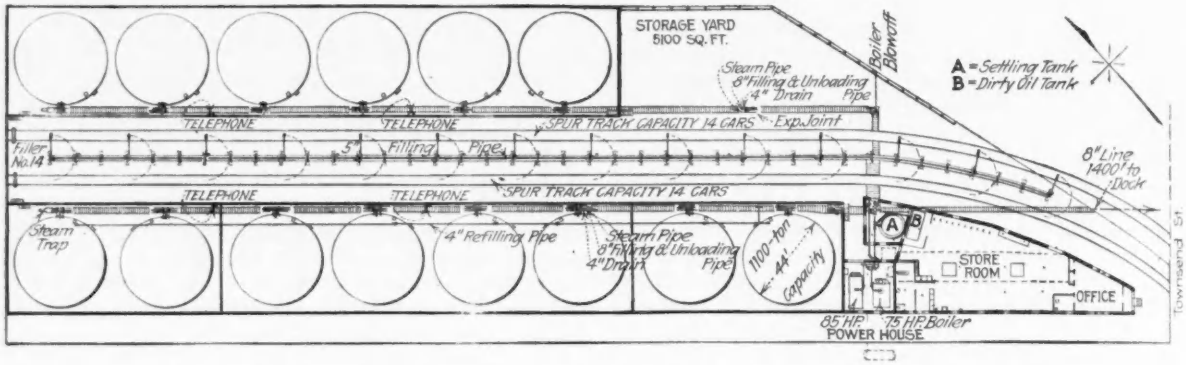
It should be possible to make so extensive a soil survey over a line that a variation in thickness corresponding to variation in conditions could be computed. Railroad bridges are not all designed of the same strength regardless of span length, nor does a hydraulic engineer design all dams of the same section regardless of height. Until highway engineering is reduced to a basis of accurate design for the special conditions met, it will still be considered guesswork, requiring judgment but not a high grade of technical engineering ability.

It is true that more exact highway design requires new data, such as the bearing power of soils, slab reactions, etc., now little developed. From this viewpoint the tests completed and proposed by the Bureau of Public Roads, described on p. 234 of this issue, are of special interest. It is to be hoped that this open field for investigation will be entered, and the experiments pressed to the utmost.

Handling Vegetable Oils at Pacific Coast Port Terminals

Traffic Has Developed Rapidly—Puget Sound Transshipped 90,000,000 Gallons Last Year and the Oil Terminal Question Is Receiving Attention Along Entire Coast

VEGETABLE oils imported from the Orient have increased in quantity very rapidly within the past year or two, and extensive provision for handling them has been made at several Pacific ports. The heaviest traffic has naturally sprung up with ports of the northwest because the northern route from the Orient to our Eastern centers is the shortest. Moreover, Seattle had recently undertaken a progressive scheme of port improvement and was in a position to add to its freight-handling facilities equipment specially for the convenience of oil shippers. Other ports of the Puget Sound district, particularly Tacoma and Everett, have also profited by trade in the new commodity. At San Francisco existing facilities have been developed wholly by private enterprise, but the State Harbor Commission has under way a survey of the need for vegetable oil equipment. The Port of Los Angeles likewise expects to spent for a vegetable oil terminal such part of a recent harbor improvement bond issue as the growth of the traffic may seem to warrant.



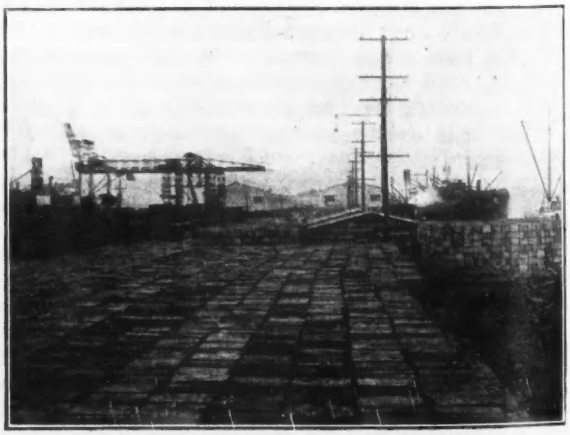
LAYOUT OF PHILIPPINE VEGETABLE OIL COMPANY'S TERMINAL AT SAN FRANCISCO

An idea of the extent to which shipments of vegetable oils have increased is conveyed by the recent statement of George F. Nicholson, chief engineer of the port of Seattle, that approximately 90,000,000 gal. of vegetable oils were handled through Puget Sound ports in 1918. Of this total, 60,000,000 gal. was handled through the port of Seattle and the remainder in smaller cities nearby.

In both figures quoted, soy bean oil made up 50 per cent. of the total, the remainder including oils made from the castor bean, cocoanut, peanut, rapeseed, wood, cottonseed, hempseed, perilla, sesame, and also from a few other sources. Tank storage capacity for vegetable oils totaling about 15,000,000 gal. has been developed in the port of Seattle and open storage for cased oil totaling about 25,000,000 gal. is available. There have been times in the past year when this capacity has been taxed.

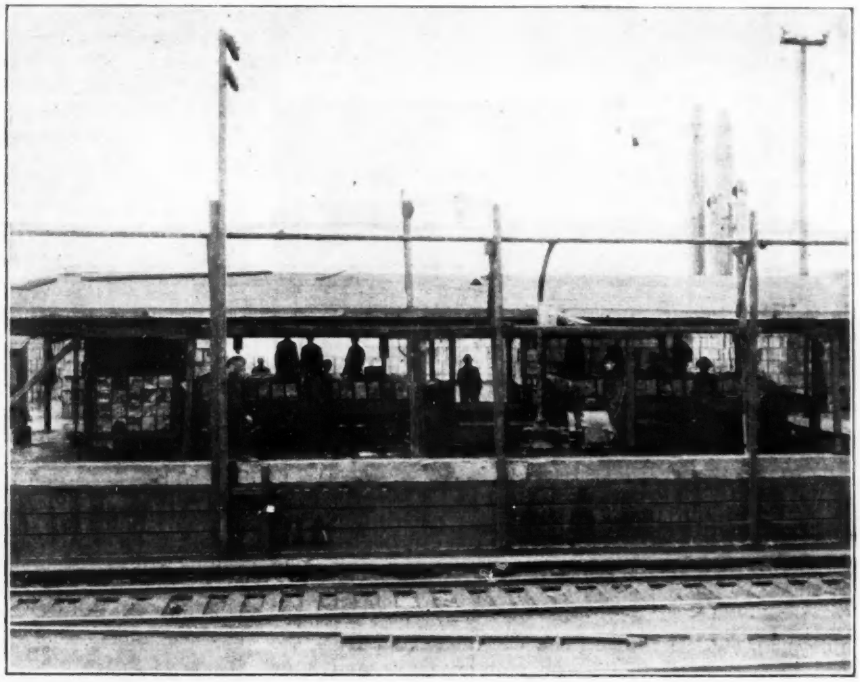
The soy bean oil as received at Seattle is shipped from the Orient almost exclusively in 5-gal. cans, two cans being packed in a wooden box, this being called a case of oil. Shipping oil in this manner always involves leakage, which has been found to average about 2%. With the oil worth 15 cents per pound this amounts to a considerable financial loss. Another disadvantage is that before the oil can be transshipped it has to be emptied from the cases, as in this country it is practically always transported in tank cars.

There are several reasons, however, why port authorities expect oil to continue to come across the Pacific in cans. Primarily, the great majority of bean growers of the Orient own only a few acres which they harvest themselves, extracting the oil by means of a small press resembling the old cider press. Oil so extracted in the Orient goes by barge down the rivers to one of the chief seaports where it is loaded on a vessel whose cargo consists of probably 300 or 400 small consignments. Eventually a large company will doubtless erect big presses at the chief seaports and the oil can then be expected in bulk shipments. This is not so simple as it might seem, however, because the laws of China prevent the shipment of beans from one province to another, and even after the present shortage of tank steamers is remedied, it must be remembered that the chief exports from this country to the Orient are iron, steel and lumber, which cannot go in tank steamers without great loss of cargo space. Thus, the provision which has developed in Puget Sound ports, at least, has been for receiving cased oil, emptying the cans and pumping the oil into storage from which it can be conveniently delivered to tank cars.



CASED SOY OIL AT SEATTLE WAITING TO BE BULKED FOR TANK CAR SHIPMENT

A large part of the vegetable oil handled at Seattle is unloaded at the Smith Cove dock, which can accommodate 5,000,000 gal. of cased oil on the open dock and 800,000 gal. in concrete tanks beneath floor level. There is a 6-in. pipe line extending to a 2,500,000-gal. tank near the dock owned by a private company and the Port Commission is now building a 500,000-gal. steel tank for increasing the dock storage. Besides the pumps and pipe systems there are also steam-heating rooms for the liquefying of cocoanut oil, which have a capacity of about six tank cars per day. The railway trackage at this dock is sufficient for a total of 40 tank cars.



TABLES WHERE OIL IS BULKED BY HAND AND PUMPED FROM A SUMP

The largest private company handling vegetable oil at Seattle is the Rogers Brown Co., which has an oil terminal on Harbor Island. Here storage for 8,240,000 gal. is provided in 27 steel tanks ranging from 30,000- to 500,000-gal. capacity and in 30 wood tanks from 5000- to 50,000-gal. capacity. They also have outside storage space for 5,000,000 gal. of cased oil. The equipment on Harbor Island includes a $25,000 heating plant, a system for cleaning pipe lines and tanks by compressed air, and a series of eight dumping tables at each of which 50,000 gal. per day can be dumped from cans and pumped to tanks or tank cars. Railroad trackage is provided for the simultaneous loading of 55 tank cars.

The problem of mechanical equipment for the economical handling of vegetable oil under present conditions has been the subject of much experimenting. In Seattle both the Rogers Brown Co. and the Port Commission are now operating machines for opening and emptying the 5-gal. cans. At least six different types of machine have been previously tried out on this work, none of which was successful enough to be retained in service. The latest type has been in use only a short time, but thus far seems very satisfactory. It takes the cans from a conveyor and, with the can on its side, releases the oil by cutting both heads. A plunger then flattens the can, forcing out any oil that remains, and the flattened tin is delivered to a press resembling a hay baler.

Previous to the development of this machine, and in the interim between experiments with its predecessors, the cans were cut open by hand on the oil tables where they were overturned to drain into a pump sump. The empty cans were heaped in great piles on shore where coolie labor cut in the two heads, the headless can being then collapsed by hand and pressed into bales in a hydraulic press. The bales go back to the Orient, where the metal is recast.

At San Francisco conditions differ radically from those at Seattle. Most of the oil handled at San Francisco comes from the Philippines and the Dutch East Indies and is handled in bulk. Moreover, cocoanut oil predominates, the quantity of soy bean oil being almost negligible. Of the 34,000,000 gal. of vegetable oil handled at San Francisco during 1918 about 32,000,000 gal. was cocoanut oil, the remainder being an assortment of the varieties previously mentioned.

Because of facilities furnished at the shipping points in the South Seas and on San Francisco Bay, the cocoanut oil is handled in bulk. Nearly all cargo steamers on this run have tanks of capacity from a few hundred tons up to 1000 or 2000 tons in which cocoanut oil can be carried. These tanks are filled by hose while the general cargo is being loaded, and are emptied in the same manner. Several San Francisco piers have pipe lines to storage tanks nearby and the oil is pumped without interfering with the handling of the general cargo. The quantity of oil shipped has been rapidly increasing and of late there have been occasional full cargoes aggregating 10,000 to 12,000 tons of cocoanut oil shipped in bulk.

Although existing facilities at San Francisco are all privately owned, the California Board of State Harbor Commissioners is planning to make special provisions for handling vegetable oil. The first move will be the construction of an oil terminal where bulk, case and barrel oil can be stored and reshipped. The initial installation will be for 1,500,000-gal. bulk storage, 3,500,000-gal. case storage, with space for extensions as required. The case-storage area will have a tight floor so that leakage may be caught and drained into sumps. The plant will be provided with the necessary heating and pumping equipment, pipe systems and railway trackage.

As an adjunct to this plant a barge is now being equipped for taking oil from vessels while general cargo is being discharged. This barge will meet the condition of a general cargo steamer carrying a small consignment of cocoanut oil and being unwilling to move to an oil terminal dock specially to unload the oil. The barge will be equipped with steam-heating plant, pumps, flex-

PREPARING TINS BY HAND FOR RESHIPMENT OF OIL TO THE ORIENT

ible pipe, etc., so that oil can be transferred from the oceangoing vessel to its own storage tanks and later delivered to the desired oil terminal. The barge will have a tank capacity of about 190,000 gallons.

Despite the lack of municipal provision for accommodating a vegetable-oil trade at San Francisco it has nevertheless built up rapidly. The total storage capacity for bulk oil now aggregates about 14,000,000 gal. and for case and barrel oil about 3,000,000 gal. Seven San Francisco companies carry on an extensive business in vegetable oils and of these five have steel storage tanks ranging from 275,000 to 1,450,000 gal. Two companies have dumping tables where oil is taken from barrels or cans and transferred to tank cars.

The largest individual plant at San Francisco is that of the Philippine Vegetable Oil Co., which has fourteen 1100-ton steel tanks served by a 1400-ft. pipe between dock and storage yard. The tanks are in a double row between which run two railway tracks with space for 28 cars. Fourteen can be loaded simultaneously. This plant has a boiler capacity of 160 hp. and has been designed for the maximum of economy and safety in handling vegetable oil. The fire-insurance rate, which was at first set at 67c., has been reduced to 27c. since the plant has been in operation. This company, one of the pioneers in the industry, owns 235 tank cars, and four motor ships which carry about 12,000 tons per month from the Manila plant to San Francisco or European ports. It also operates an oil terminal at Tacoma which has five storage tanks ranging in capacity from 333 to 3000 long tons. Cocoanut oil freezes at 68 deg. F., and at this northern terminal it was thought best to have the storage tank housed in and to keep the temperature in the building at about 80 deg. This keeps the oil in fluid state. At this terminal oil is unloaded from vessels by means of portable steam pumps which are put down in the hold after the oil has been heated to about 110 deg. Each of these pumps, with an 8-in. suction, can handle about 400 tons per hour. They are usually served by steam from the vessel's own engine room, but flexible steam connections from shore are provided when necessary. The steamers delivering to this terminal each have an oil-tank capacity of 1000 tons. This is ordinarily emptied overnight. The tanks have to be emptied, "steamed down," washed with hot salt water and equipment cleared away between 5 p.m. and 8 a.m., to avoid interference with stevedores. A fleet of about 10 steamers averages three deliveries per month at the Tacoma plant.

The pipe from wharf to tanks is 1000 ft. long and 8 in. in diameter. It is housed in a wooden box with a 2½ x 2½-ft. space inside and is heated by a steam line to keep the oil in fluid condition. From the storage tanks the oil is delivered to 110-gal. steel drums or to tank cars. Spur trackage sufficient for 30 cars is provided. When this plant was being erected the fire-insurance rate quoted was $2.55 per hundred. This has since been reduced to 60 cents per hundred.

The fire marshal at San Francisco requires that all oil-storage yards shall be provided with concrete walls that in case of failure of all the tanks the storage capacity within the wall would be sufficient to hold all of the oil, and this provision is observed at all of the vegetable-oil terminals. In commenting on the fire hazard of vegetable oils in general, the fire marshal in another coast city recently said: "Besides special handling equipment, another provision that the port engineer must not overlook in planning for the oil trade, is fire protection. The vegetable oils are not likely to originate a fire *per se*, except as oily fabrics might start spontaneous ignition. But, oil-soaked wooden containers and wharves have been found to ignite

OIL TERMINAL OF PHILIPPINE VEGETABLE OIL COMPANY AT SAN FRANCISCO

Concrete walls provide emergency containers equaling tank capacity. Note distance from docks in background.

readily and burn with an intense heat, and large quantities of the oil itself have developed a fire that 3- and 4-in. streams from fireboats have been unable to extinguish. Last year in a Pacific port about 1100 gal. burned with terrific heat in the mass of wood and tin containers or poured in a flame from the open wooden wharf down to the water. The blazing oil on the water spread rapidly over a large area and the flames rose

to great height. Fortunately, a light wind drifted it away from other valuable property.

"The difficulty of guarding against such hazards depends largely upon whether there is solid earth under the surface upon which the oil is stored; in any case, there must be walls or curbs to prevent the overflow of the oil and ample fire walls to protect buildings. If the dock is on open piling the floors must be so protected by concrete, sand or similar material, that they will not give way in from four to six hours of intense heat. If these safeguards can be provided the conditions will then be advantageous for a liberal installation of an approved foam extinguisher. This seems to be the best method of controlling such a fire if the foam be in sufficient volume and properly distributed. If the burning oil is allowed to reach the water the safety of adjoining property will depend upon wind and tide."

Malaria Caused by Nondrainage of Irrigated Lands

Wet Areas Due to Seepage From Irrigation Canals Result in Loss of Health and Lowering of Property Values

ECONOMIC loss due to malaria in an irrigation district in California, in 1918, averaged $31.70 per family for medicine, medical service and labor loss, with a range from $1.86 to $75.10 in different parts of the district. This is the conclusion of Harold F. Gray, state district health officer, in a report to the California State Board of Health, printed in the *Journal* of the American Medical Association of May 24, 1919.

The report relates to the Anderson-Cottonwood irrigation district of about 32,000 acres along the Sacramento River, having a population of about 1300, half living on farms and the remainder in two towns. This district was organized in 1914 and the irrigation system—supplied from the river—was able to serve the northern part of the district early in 1918, while some water reached the southern part late in the season. As the soil varies from loam to gravelly loam and the main canal is on a side hill, the seepage from the canal and laterals has increased existing wet areas and caused new pools and marshes, bringing about ideal conditions for the breeding of anopheline mosquitoes. In fact, this is the dominant species. Except for unusual years, mosquitoes did not prove troublesome until the introduction of irrigation in 1918, but in that year they were the cause of universal complaint in the irrigated sections, while Dr. Gray states that in many places they seem to have made life nearly unendurable.

In view of the probable effect of irrigation in increasing malaria, already endemic in this district, Dr. Gray made his studies in order to determine the facts as a basis for recommendations as to its control. Special attention was given to the economic loss, since a tax for malaria control in addition to the heavy tax burden already existing would need evident justification in order to receive the support of the people. Practically every house was visited and data were obtained from 80% of the families, care being taken to underestimate rather than overestimate the probable cost of malaria to the family, and large items being checked by corroborative evidence where possible.

Medicine included quinine, calomel, prescriptions and "patent medicines" purchased by the patients. Medical service included physicians' fees, nurses' wages, hospital expense and medicine given by the attending physician. Labor loss included only that of the head of the household, or other wage-earning members of the family, charged at the local scale of $4 per day. These three items were selected because they could be ascertained with some degree of certainty. Of 1081 persons, 590, or 54.5%, had malaria symptoms. The cost per family for the year, as stated above, was $5.70 for medicine, $7.10 for medical services and $18.90 for labor loss, making a total of $31.70. With families averaging 4.16 persons, the cost was $7.66 per capita or $14.05 for each sick person.

Other costs are listed for which no accurate figures were obtainable. Thus, the six deaths averaged probably not less than $100 per funeral besides the economic value of the lives lost. Loss by inability to handle crops at proper time, owing to malaria attacks, amounted to $120 in one case. Nine families intended to leave the district on account of malaria, with probable loss on forced sale of property, while there was further loss due to families being deterred from buying land and settling. There was loss in much property being vacant on account of malaria, and in 20 such cases the annual rental was about $200. Loss due to families removing from the district in summer on this account will average about $50 per family, and there is, besides, the economic loss to the community. Depreciation of property value due to the presence of malaria and mosquitoes is taken as $5 to $10 per acre.

Drainage and mosquito-control work is estimated to cost $22,400 in the first year, $5000 in the second year and then $3800 annually. Of the first year's expense, $12,000 is allowed for agricultural drainage and correction of interference with natural drainage which would be required regardless of malaria. Estimating a reduction in malaria of 50%, 75%, 90% and 95% for the first four years, this work should eliminate, in savings, the malaria cost due to medicine, medical service and labor loss, while it should show a considerable profit in other items, particularly in appreciation of property values. Dr. Gray states that experience in California shows that the above reduction percentages are readily obtainable. The organization of a mosquito-abatement district, under the California law, has been advised as the first step in measures for control of malaria.

Canada's Electric Generating Plants

Canada has 565 electric generating plants supplying current for sale, according to an extensive descriptive report and summary by L. G. Dennis, just published by the Canadian Conservation Commission, Ottawa, Ont. These plants, which have an aggregate capacity of 2,107,743 hp., give service in 973 places, through 752 distributing systems. There are 270 hydro-electric plants, with a total of 1,806,618 hp.; 201 steam-driven, with 282,202 hp.; 49 gas plants, with 8157 hp.; and 45 oil- or gasoline-engine plants, with 4766 hp. Municipally owned plants number 207 and have 452,508 hp. altogether. There are 358 privately owned plants with a total of 1,655,235 hp. The Niagara system of the Ontario Hydro-Electric Commission (public) has a total load of 210,000 hp. and supplies some 120 municipalities. The Shawinigan Water & Power Co., of Quebec, has a load of 205,000 hp. and supplies, directly or indirectly, about 75 places.

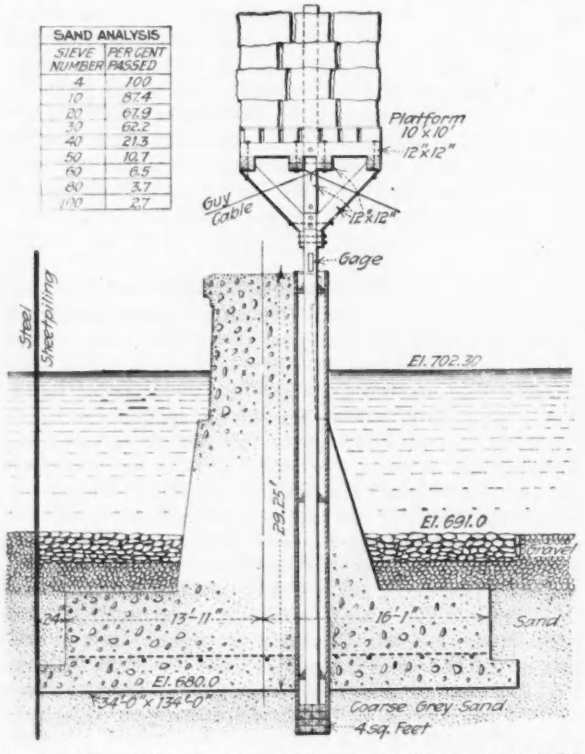
Test of Sandy Foundations at Arch Bridge Pier

Settlement Measured by Gage at Top of Timber Mast Passing Through Completed Concrete Base—Stone Blocks for Load

By Arthur Richards
Deputy County Engineer, Columbus, Ohio

A UNIQUE foundation soil test was made at one of the piers of the Broad Street bridge, Columbus, Ohio, in order to determine the bearing power and settlement under load of the sandy material below the pier. This test was conducted after the pier had been completed up to the springing line of the main arches, so that the sand was in a normal loaded condition and confined to preclude any upward movement adjacent to the bearing block. Large stone taken from an old abutment was used for the load, and applied on a platform at the top of a long mast extending through the pier. This platform was loaded rapidly up to about 11,500 lb. per square foot and finally to 18,350 lb. without any special consideration as to time of application; the object was to determine the action under long periods of load.

The test shaft was placed near the center line of the bridge in a sump opening through the pier which had been used to keep the cofferdam unwatered as the concrete construction proceeded. The bottom of the sump was dug out about 3 ft. lower than the footing of the pier, and it was this lower elevation at which the test shaft was begun. The first section of the shaft box was 10 ft. long. In the lower end was inserted a built-up block of wood 24 x 24 x 24 in. which was nailed to the shaft box to prevent upward movement,



DETAILS OF TEST APPARATUS AND RESULTS OBTAINED

RESULTS OF SOIL TEST AT ARCH BRIDGE PIER

Time	Time Interval Hr.	Min.	Lbs. per Sq.Ft.	Total Settlement, Ft.	Time	Time Interval Hr.	Min.	Lbs. per Sq.Ft.	Total Settlement, Ft.
3-27-19					2.30 p.m.	0	5	11,520	0.05
10.00 a.m.			1,275	0.00	3.00 p.m.	0	30	11,520	0.06
3-28-19					3-29-19				
1.37 p.m.			1,936	0.00	10.00 a.m.	19	0	11,520	0.06
1.40 p.m.	0	3	2,780	0.00	10.20 a.m.	0	20	12,275	0.06
1.44 p.m.	0	4	3,742	0.00	10.25 a.m.	0	5	13,125	0.08
1.50 p.m.	0	6	4,456	0.00	10.30 a.m.	0	5	13,980	0.10
1.53 p.m.	0	3	5,210	0.00	10.40 a.m.	0	10	14,705	0.11
1.56 p.m.	0	3	6,215	0.01	10.45 a.m.	0	5	15,699	0.12
2.00 p.m.	0	4	7,165	0.02	10.50 a.m.	0	5	16,599	0.13
2.05 p.m.	0	5	8,036	0.03	10.55 a.m.	0	5	17,250	0.14
2.10 p.m.	0	5	8,897	0.05	11.00 a.m.	0	5	18,350	0.15
2.15 p.m.	0	5	9,832	0.05	3-31-19				
2.20 p.m.	0	5	10,488	0.05	8.00 a.m.	45	0	18,350	0.15

but which could be displaced downward when a few hundred pounds of weight was placed upon it. The sump was filled with excavated sand up to the level of the bottom of the pier footing, and the concrete placed in this sump opening was carried up around the shaft box. This box was 2 x 2 ft. in cross-section and was carried vertically up to the elevation of the springing line.

Shortly after the pier was completed a 10-ft. flood occurred in the Scioto River, which delayed the beginning of the test for two weeks. Just prior to the placing of the test mast in the shaft, about 2 ft. of silt and sand which had been deposited therein during the flood was blown out of the shaft with a steam jet. The elevation of the water during the test period within the shaft and about the pier was 702, as illustrated in the drawing.

A 12 x 12-in. fir derrick boom was used as the loading mast, with guards to keep it vertical during the test and prevent deflection. The test platform, as illustrated in the photograph and drawing, was built up of 12 x 12-in. timbers. Some of the bolt washers, because of excessive weight on one side to balance the platform, were indented into the timber not more than $\frac{3}{16}$ in. during full loading, and the lower 12 x 12-in. brace on one side had a deflection of several inches. The large stone used for loading the mast varied in size, shape and weight, so that it was difficult to keep the load properly balanced at all times. Guy cables were therefore used to hold the mast in position during unequal loading, but for the test periods of 19 hours and 45 hours the platform was evenly balanced. The rope shown in the photograph extending over the top of the platform was the life line to be used by the workmen in the event of the failure of the platform.

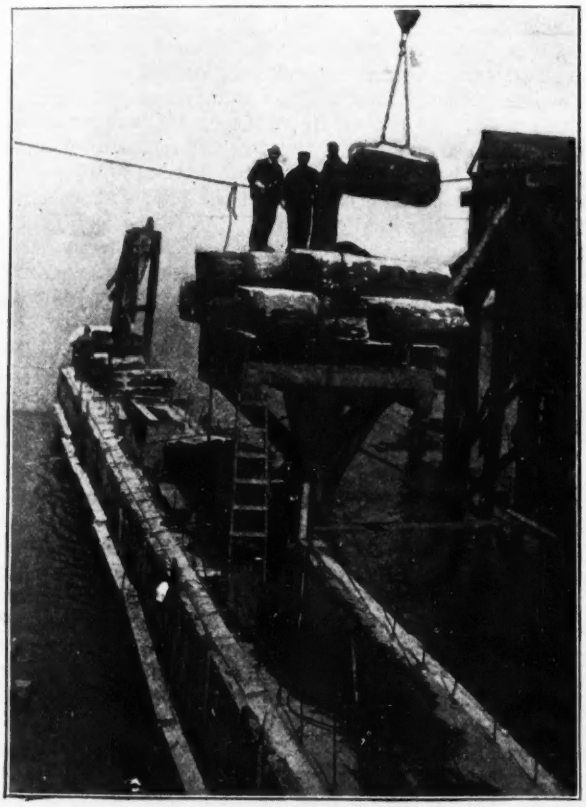
The large stones used in the test were taken from the west abutment of the old bridge and were placed on the platform by a derrick; each stone was numbered and measured and its weight was computed. This stone was red and yellow sandstone and its weight per cubic foot was obtained by taking various samples, about 20 lb. each, and finding their displacement in water. The weight per cubic foot used in calculating the platform loading was 130 pounds.

The platform was constructed and attached to the mast before the latter was placed in the shaft. The entire weight of mast and platform was dropped clear of the last foot in order that the block at the bottom of the shaft would be loosened from the shaft box. A gage divided into hundredths of a foot was placed on the mast near the top, the indicator was adjusted, and the loading was begun the next day.

All the piers of the bridge rest upon coarse gray

sand which extends below the footings about 40 ft. and overlies about 20 ft. of blue hardpan on limestone bedrock. The total maximum toe pressure which will exist at any pier is computed to be about 8000 lb. per square foot, and the foundation soil test was made primarily to determine whether any undue settlement would take place. The time interval in loading therefore received no special consideration, as it was desired to see what action took place under a load over a long period of time. The platform was therefore loaded rapidly until a load of 11,520 lb. per square foot was obtained. As indicated in the table of results, it is seen that there was a total settlement of 0.06 ft. shortly after the first full load was applied, and that this remained constant for a period of over 19 hours. Additional weight was then applied until a pressure of 18,350 lb. per square foot was obtained, with a total settlement of 0.15 ft., which remained constant for a period of 45 hours.

It is evident that as the pier was being constructed up to the springing line, a small settlement had taken place, and that as the arches and the fill over the arches are placed there will be additional small settlements. From the test results it would appear that in this case after settlement had occurred for a specific load there would be no additional settlement in the future under the same load. With a pressure of 8000 lb. per square foot a total settlement of 0.04 ft. can be assumed; and as probably half of this will occur before the arches and superimposed loads are placed, it will only be necessary to provide for 0.02 ft. settlement when considering the placing of the arches. This is considered negligible.



LOADING THE TESTING PLATFORM FOR SOIL TEST

During the construction of the next pier it is intended to embed a vertical steel rod in the footing, and then make note of the settlement which takes place during the remainder of the construction of the bridge.

As the load was removed from the platform the gage was observed; after all the stone had been removed there was no change in the reading. The lower end of the mast was examined, and one end was found to be slightly crushed, although the general appearance indicated that the load had been evenly distributed. Improvements in the test apparatus would result if a steel plate on top of the bearing block and another at the bottom of the mast were used, and also by framing around the mast at the gage in order to prevent sidewise motion.

The cost of the test was as follows:

Test shaft, labor and material	$176
Platform, labor and material	172
Placing and loading platform	135
Dismantling platform	65
Extra, concreting test shaft	37
State liability insurance	32
	$617

The Broad St. bridge is a reinforced-concrete structure consisting of seven arch spans, and is being built by the Carmichael-Cryder Co., of St. Louis, at a cost of $650,000. The work is being done for Franklin County, Ohio, under the supervision of John Dun, county engineer.

Bonding New to Old Concrete

SMALL-SIZE tests on mortar and concrete specimens in direct tension, shear and cross-bending have led W. E. Rosengarten of the United States Bureau of Public Roads to the following conclusions (reported in the official paper of the Bureau, *Public Roads*, for June, 1919) regarding the practice in bonding old to new concrete:

By careful treatment new concrete can be made to adhere to old with a strength equal to 60% of monolithic concrete. If a greater bond than this is desired it will be necessary to resort to dowels drilled into the old concrete.

If no special treatment is given the old concrete other than cleaning off foreign substances before adding the fresh concrete, a bond of but 20% of the monolithic concrete is developed.

The surface of the old concrete can be roughened or treated with a 1:10 dilute solution of hydrochloric acid which will increase the bond by 20% of the strength of the monolithic concrete.

A bonding medium of a thin layer of neat cement butter spread over the surface of the old concrete will increase the bond 20% the strength of the monolithic concrete.

Tamping the fresh concrete hard against the old concrete, forcing the cement into the pores, increases the bond 5% of the strength of the monolithic concrete.

The above conclusions refer to a rich concrete—namely, 1:$\frac{3}{4}$:1$\frac{1}{2}$—and for leaner mixes the percentages very likely would be increased.

The shearing strength of a joint is greatly increased by a treatment of the surface of the old concrete, and although it may slightly increase the cost of the work, the added effect would certainly seem desirable. The results of this series show that there is no danger of leakage at a joint made in concrete of a mixture as rich as 1:$\frac{3}{4}$:1$\frac{1}{2}$, under pressures up to 40 lb. per square inch; when the surface of the old concrete has been treated.

Substructure of Michigan Avenue Bascule Bridge, Chicago

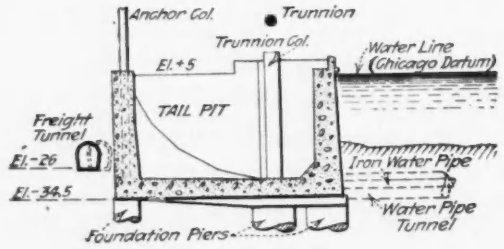
Cylinder Piers Sunk to Rock and Hardpan Carry Large Concrete Tailpits for Double-Deck Bridge—Steel Columns Embedded In the Walls Support Girders for Trunnions and Uplift Anchorage

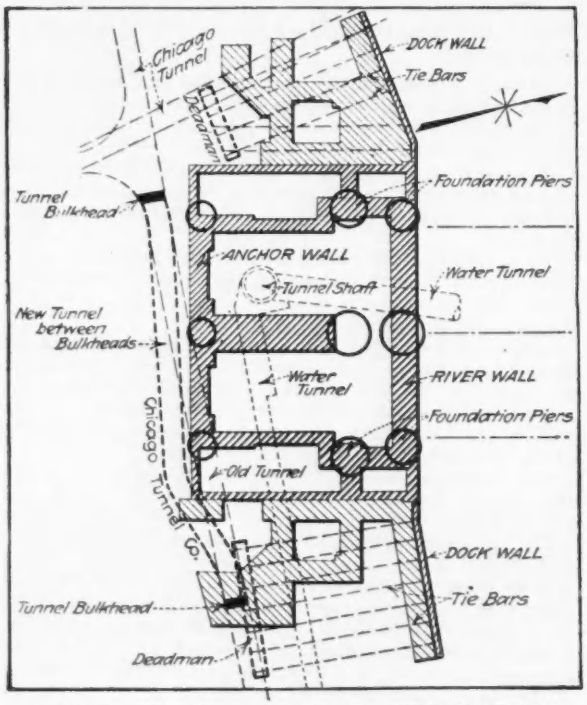
By Hugh E. Young and William A. Mulcahey
Engineer of Bridge Design, City of Chicago
Engineer of Construction City of Chicago

REINFORCED-CONCRETE boxes or tailpits about 95 x 67 ft. in plan over all and 40 ft. deep, with their floors 34½ ft. below water and supported on concrete cylinder piers, form the principal parts of the substructure for the 254-ft. double-deck bascule bridge across the Chicago River at Michigan Ave. Braced cofferdams about 75 x 100 ft. were required, one of these being in 22 ft. of water. Open wells for the piers were sunk after the excavation had been carried down to the floor of the tailpit. Tunnels for water-supply and freight traffic were encountered, and a break in one of these caused the flooding of a cofferdam.

This bridge will be a double-leaf four-truss structure of the trunnion type, with a span of 254 ft. between trunnions and a clear width of 220 ft. between masonry piers. It is a part of the Michigan Ave. improvement to form a new link between the boulevard systems of the north and south sides of the city.

Each pit is a monolithic structure, 52 x 66 ft., inside





PLAN OF SUBSTRUCTURE FOR SOUTH PIER SHOWS INTERFERENCE WITH TUNNELS

at the floor level. Its front wall or river pier and its rear wall or anchor pier are each supported on three cylinder piers. In the rear wall are embedded the steel anchor columns carrying girders or floor-beams which serve to take the upward reaction at the bumper blocks due to the live load on the river arm of the bascule leaf.

Transverse beams at the bases of these columns distribute the uplift to the concrete wall. The side walls are supported at their ends by the river and anchor walls and at intermediate points by cylinder piers carrying the girders for the trunnion bearings. At the ends of the side walls are brackets supporting cantilever shelves which form horizontal girders to reinforce the sides against lateral loads. These cantilevers also carry the masonry of the inclosure walls and columns supporting the sidewalks of the two decks on the fixed portion of the bridge.

To carry the trunnion bearings there is a heavy steel cross-girder behind the river wall, its ends resting on the side walls directly above the cylinder piers under these walls. At the center of the girder, where are located the bearings of the two middle trusses, it is supported by a heavy steel column seated on an independent cylinder pier beneath the floor of the pit. This column is braced longitudinally by a steel A-frame which has its toe in the river wall and is incased in concrete.

Of the 18 cylinder piers, nine to each pit, varying from 7½ to 12 ft. in diameter, one is carried to bedrock at a depth of 108 ft. below water line or city datum. This pier is formed with a shallow taper footing. The other piers are carried only to the hardpan, at depths of 80 to 90 ft. below datum. In these the bottoms are belled out for about 6 ft. in height to give a base diameter equal to 1½ times the diameter of the body of the pier. The maximum load per square foot allowed on the base of the footings is 25 tons on rock and eight tons on hardpan.

Owing to the great depth to which the tailpit is carried, its base being 34½ ft. below the water line, it was necessary to provide a heavy floor to withstand the upward pressure. This floor is 5 ft. 3 in. thick, including a 6-in. waterproofing course near the middle of its depth. At the center a rib or beam on the underside of the floor-slab is provided to carry part of the floor loads and the reactions developed from lateral loads on the anchor pier.

To provide supports for the rails of the emergency brake system, having toggle-joint brakes which act on the curved heels of the trusses, four concrete walls are built in the pit in line with the ends of the trusses. These are stepped at the top to permit of a good bond with the concrete and grout which will be placed when the brake rails are installed.

A stone concrete of 1:3:5 mix is used throughout, and to all the concrete of the tailpits was added hydrated lime in the proportion of 10 lb. of lime to 94 lb. of cement.

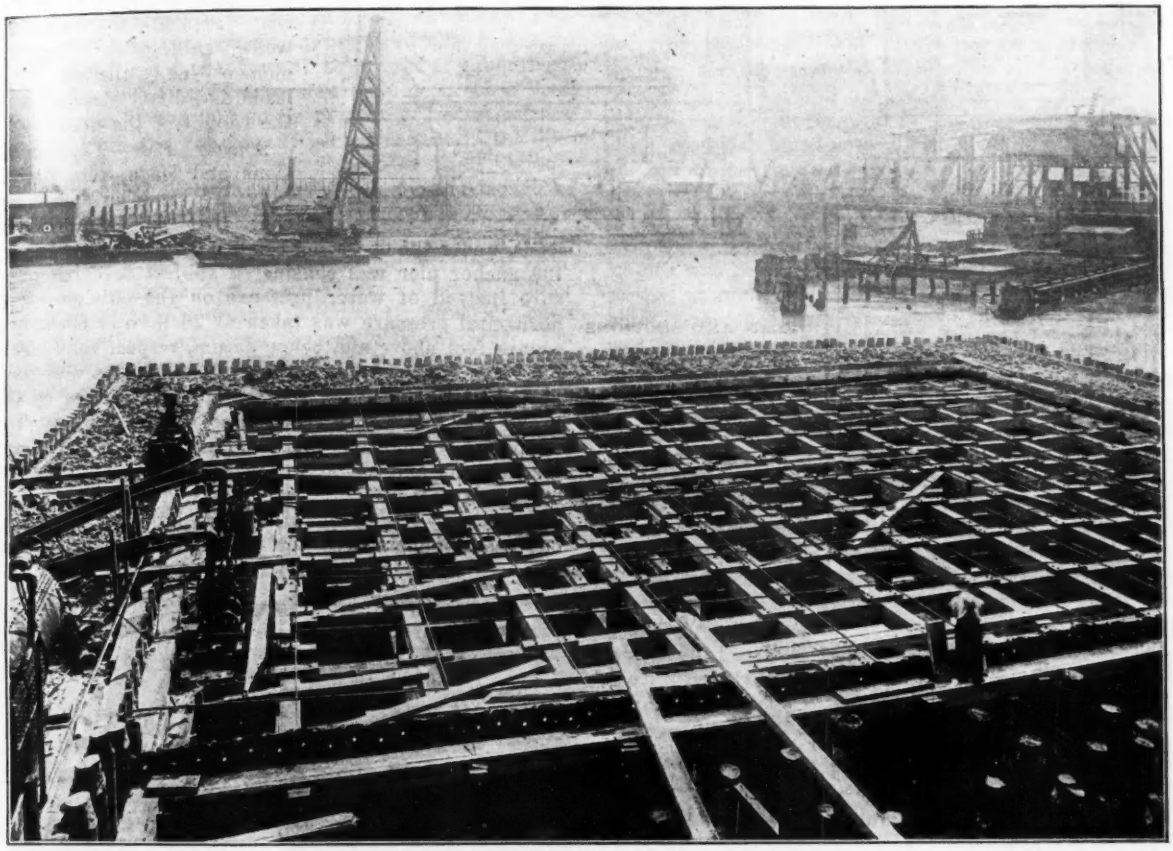
For waterproofing, a 6-in. layer of 1:2 mortar, made of portland cement and fine aggregate, is placed in the

floor and on the outside faces of the walls, the thickness being reduced to 4 in. in the upper portion of the latter. This was carried up with the concrete, a 12-in. plate with angles on the inside being placed against the form to insure a uniform thickness of the facing.

The 45-ft. steel column supporting the middle of the trunnion girder is about 51½ x 22½ in. in section, with

tending back to concrete stringers or deadmen embedded in the fill. As the tower and dock wall foundations are independent of the bridge substructure, they are not affected by the bridge loads and vibrations.

Each concrete box pier or tailpit is designed to carry its own dead weight, water pressure from without and —to a certain extent—water pressure from within. This latter condition is brought about with the pit filled



COFFERDAM, 75 X 105 FEET INSIDE, FOR NORTH PIER OF MICHIGAN AVENUE BRIDGE, CHICAGO RIVER

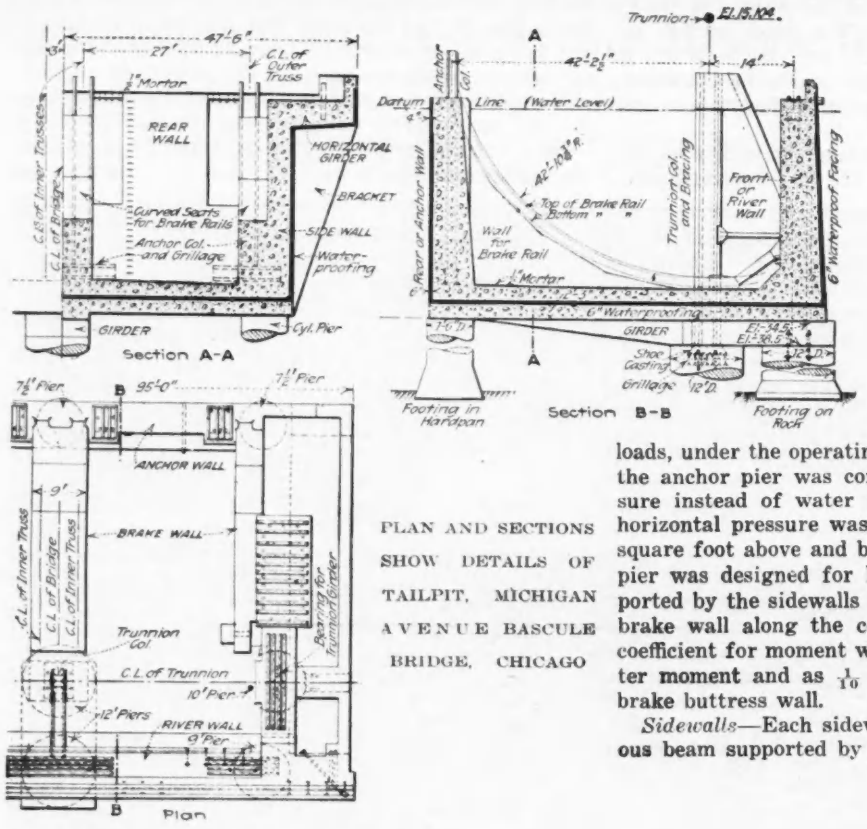
three 22-in. webs between the 50-in. side plates, as shown in the drawing. This shows also the A-frame brace. Provision is made for placing shim plates at all bearing points of the girder, in order to permit of adjustments in case of any difference in deformation of the sidewalls and the steel column under the dead load of the bridge. As the anchor columns are for tension loads, they are of relatively light construction. Each has two built-up sides of channel section connected by batten plates and lacing. These columns are 60½ ft. long, weighing 10 tons; they were erected complete, requiring a long spliced boom on a floating derrick to lower them vertically through the pockets formed by the bracing of the cofferdam. Between these columns are framed the 52½-in. floor-beams.

Concrete slab foundations on timber piles having a penetration of 18 to 20 ft. are used for the four operating towers, the spaces between the piles, behind the dock walls, being filled to the level of the base of the buildings. The dock walls are of concrete, supported on a double row of oak piles with a single line of triple-lap wood sheet piling between them. These walls are anchored or tied in place by horizontal bars ex-

with water when the final hydrostatic tests are made before the cofferdam is removed. The effect of buoyancy due to the displacement of the pit walls and floor was considered, but the displacement of the pit as a whole was not taken into account either as lessening the dead loads of these parts or as reducing the loads in the subpiers. The loading conditions assumed in the design of the tailpits are given below.

Pit Floor—Two conditions were covered. For the operating condition the pit was assumed to be empty, with water pressure on the under side of the floor equal to 1410 lb. per square foot. For the construction condition the pit was assumed to be 25% filled with water, with the soil offering no support to the floor and pressure taken at 1410 lb. per square foot.

The floor was designed as a slab—reinforced longitudinally and transversely—supported by the sidewalls and pier walls and continuous over the girder along the center line of the bridge for both upward and downward pressures of 1410 lb. per square foot. This load was distributed to the longitudinal and transverse spans in inverse proportion to the fourth power of their span lengths. For the longitudinal span the coefficient for



PLAN AND SECTIONS SHOW DETAILS OF TAILPIT, MICHIGAN AVENUE BASCULE BRIDGE, CHICAGO

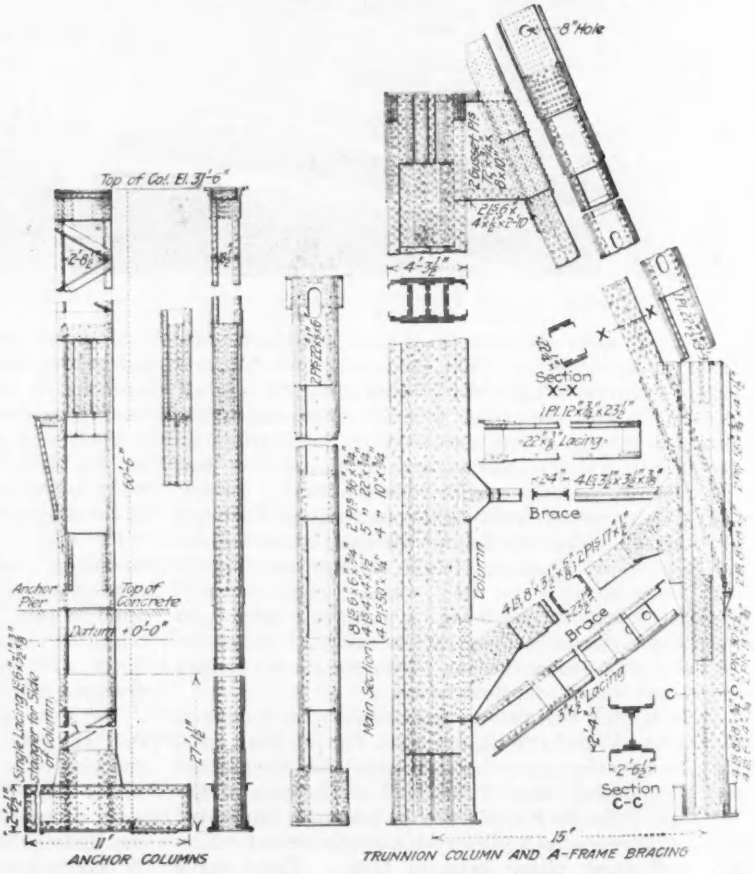
moment was taken as $\frac{1}{10}$ and provision is also made for bending moment in the floor slab induced by the cantilever moment in the river pier. For the transverse span the coefficient for moment was taken as $\frac{1}{12}$ for positive center moment and $\frac{1}{12}$ for negative ment was taken as $\frac{1}{12}$ for positive line of the bridge.

River Pier—For the operating condition the pit was assumed to be empty and the river wall or pier subject to the vertical loads of the bridge superstructure. For the construction condition the pit was assumed to be 25% filled with water and having a proportional part of this load on the floor carried by the river pier. The loads for these conditions are as follows: Pit empty; dead load of superstructure; 75% live load of superstructure; concrete in pier above datum at 150 lb. per cubic foot; concrete in pier below datum at 90 lb. per cubic foot. Pit 25% full; no superstructure loads; concrete in pier at 150 lb. per cubic foot.

For vertical loads this pier was designed as a beam continuous over the three cylindrical subpiers as supports. For horizontal loads, under the operating condition, the pit was assumed to be empty and the river pier subject to water pressure on the outside, while for the construction condition the pit was assumed to be filled with water to datum (for testing the pit for leaks) with the cofferdam in place and, therefore, no external pressure. The method used in the design of the river pier for horizontal loads is similar to that applied to retaining walls subject to bending moment due to the horizontal loads and direct stress due to the weight of the masonry.

Anchor Pier—The conditions and loads were practically the same as above, except that as to horizontal loads, under the operating condition with the pit empty, the anchor pier was considered subject to earth pressure instead of water pressure on the outside. This horizontal pressure was taken at 28 lb. and 60 lb. per square foot above and below datum, respectively. This pier was designed for horizontal loads as a slab supported by the sidewalls and the buttress formed by the brake wall along the center line of the bridge. The coefficient for moment was taken as $\frac{1}{10}$ for positive center moment and as $\frac{1}{10}$ for negative moment over the brake buttress wall.

Sidewalls—Each sidewall was designed as a continuous beam supported by the river pier, the anchor pier



STEEL COLUMNS IN PIERS SUPPORT GIRDERS FOR TRUNNION BEARINGS AND UPLIFT ANCHORAGE

and the cylindrical subpier for the trunnion. For horizontal loads, under normal operating conditions the pit was assumed to be empty and the wall subject to earth pressure on the outside. For the construction condition the pit was assumed to be filled with water to datum, with the cofferdam in place and, therefore, no external loads.

Cylinder Piers—In the design of the cylindrical subpiers the operating condition produced the maximum loads, which were as follows: Dead load of superstructure, 50% live load of superstructure, concrete of wall at 150 pounds and 90 pounds per cubic foot above and below datum and 150 pounds per cubic foot in the subpiers.

This project is being carried out by the Board of Local Improvements, of which C. D. Hill is chief engineer, but the plans and specifications were prepared in the bridge-designing section of the bureau of engineering, Department of Public Works: Hugh E. Young, engineer of bridge design; Thomas G. Pihlfeldt, engineer of bridges, and John Ericson, city engineer. The Great Lakes Dredge & Dock Co. is doing the substructure work for the bridge and its south approach under three contracts which aggregate $2,350,000. Capt. William Murphy is general superintendent for the company.

Camp Beds and Bedding Service Lower Labor Turnover

Bed Service by Big Lumbering Company Reduces Cost and Retains Men—Old Floaters Rent Beds and Forget To "Roll Up and Move On"

By W. C. Ruegnitz
Bridal Veil Lumbering Co., Portland, Ore.

MEN will cheerfully pay a dollar a week rent for bed and bedding service, and a camp which houses a hundred men for a ten-months' operation can make a profit on the service. Moreover, it is found that the men will stay longer on the job and will work more energetically.

An experience extending over a period long enough to be conclusive has established the truth of these assertions. This experience was gained in a logging camp, but the same results should be as readily obtained in a mining camp or in a construction camp, where similar conditions prevail.

About two years ago an experiment in furnishing bedding was tried by the Bridal Veil Lumbering Co. at one of its logging camps where about one hundred men are employed. Two of the regular bunk houses were especially cleaned, and to the regular equipment of steel bunks and mattresses there were added sheets, pillows, pillow slips, blankets and comforters. All of the bedding was of a good quality and was warm. The beds in these houses were called "special service bunks," and a charge for their use was made at the rate of $1 per week, 25c. for each of the first four nights of each week.

Coupled with this bed service there was a shower-bath house and a drying room. Men coming in from work on wet days could leave their wet clothing in the drying room instead of bringing it into the bunk house. A laundry was established so that the men on coming in from work could have a clean change of clothing after taking their baths. No man was allowed to elect to use this special service unless he had two suits of underwear, a complete change of clothing. This was done to keep the place clean and to improve the sanitary conditions.

Applications for the use of this special service came in slowly at first. Men had been so in the habit of carrying their beds that they paid little attention to the new service; many old-timers sneered at the idea, and continued to "roll up and move on." It was difficult to get the coöperation of the foremen. Occasionally a man was hired who had no bedding. He had lost his roll or he had not worked in a camp before. He accepted the special service. Soon results were apparent. Men who had carried their beds compared the company's bedding with their own. The special-service bed was better; it was clean; it was made up daily, so that at night the men had as good a bed as the best hotel could offer, and it was actually inviting. There was no change in the building, but the environment was different.

Waiting List Soon Established for the Special Service

We soon had a waiting list of men who wanted to use the special service. The following year 50 special-service beds were put in camp. This year we have 75 special-service beds in a camp of 100 men, and a waiting list of 17 men shows the feeling the men have toward this class of service. Many have discarded their blankets, and the labor turnover in our camp has been materially reduced. The men who take the special service invariably stay longer in camp than the men who carry their bundles.

It may be interesting to know how this special service is handled. We do not use the old-fashioned "bull cook" to make the beds. A washing machine and drying room are established in one building. The linen is washed by a woman who has charge of the special-service beds. She not only takes care of the making of the beds, but sees that all the linen is clean and mended. She has as much assistance as may be necessary, according to the number of beds that are used. An enterprising woman in camp can easily work up trade among the men to do their personal laundry and mending. This personal service is one that is greatly appreciated by the men.

The following tabulation of costs will no doubt be quite surprising to many contractors or operators who have considered that it would be impossible to put in bed service with supplies of bedding. First, we will consider costs based on the old practice of supplying beds alone:

One iron bed and spring, first cost, $5; years of life, 5; annual depreciation, $1. One mattress, first cost, $3; years of life, 2; annual depreciation, $1.50. Stove and miscellaneous equipment, first cost, $3; years of life, 3; annual depreciation, $1. Totals, first cost, $11; years of life, 3; annual depreciation, $3.50.

Assuming ten months' operation, the unit cost per man per month are:

Depreciation, $0.35; interest, $0.066; labor (actual costs), $1.00; rent, light, etc., $1.00; total, $2.416.

Since, according to logging-camp practice, nothing is charged for this service, this $2.416 represents the loss per man per month. Now, let us add bedding to the

service and charge the men 25c. per night for the first four nights of each week. The additional costs are as follows:

Item	First Cost	Years of Life	Annual Depreciation
1½ heavy blankets at $10	$15.00	5	$3.00
2 light blankets at $2	4.00	3	1.33
1 comforter at $2	2.00	3	.67
4 sheets at $1	4.00	2	2.00
2 pillow slips at 25c	.50	1	.50
Total	$25.50		$7.50

Based on ten months' operation, the cost per man per month would be:

Depreciation, $0.75; interest at 6%, $0.15; labor care of bedding, $1.00; total, $1.90.

By reason of this additional expenditure there is realized a return of $4.50 per man per month or, if the beds are not all occupied, of, say, $3.50 per man per month. But beds and other equipment under special care will last longer than under the old system, so that a revised analysis of the cost of the equipment is justified, as follows:

Item	First Cost	Years' Life	An. Depr.
1 bed	$5.00	7½	$0.75
1 mattress	3.00	3	1.00
Stove and miscellaneous equipment	3.00	3	1.00
Bedding	25.00	Varies	7.25
Total	$36.00		$10.00

The cost per man per month for ten-months' operation would then be as follows:

Depreciation, $1.00; interest at 6%, $0.216; labor, $2.00; rent, light, etc., $1.00; total, $4.216.

If the beds are all filled, the returns would be $4.50 per man per month, which would give a net profit of 28c per man per month. Even if the beds are not all occupied and the return is only $3.50, the net loss per man per month is only 71.6c., as compared with $2.416. Besides the money economy, bed service produces better feeling, cleaner men.

Coupled with the special bed service, every attempt is made to induce the family man to come to camp by furnishing him with a semifurnished house that will enable him to take care of his family. The invitation to the family enables the contractor to have women in camp who can be called upon to do the work that is required by the special bed service. The two work hand in hand.

Commissary stores have received increased floor space, and tables, with reading matter on them, and pool tables, have been added. A charge is made for their use. There is no attempt at paternalism. In all cases the men pay for what they get. No varnished camps or expensive structures have been attempted. An experiment of two years along this line has demonstrated the practicability of the idea. In discussing the subject of service beds, employees have repeatedly come to us with this remark: "We have thrown our roll away, and if we can't find a camp where we can get a bed furnished we will not go to work in camp."

Home Rule Cities May Regulate Utility Rates

The Supreme Court of Colorado has decided by a 4 to 3 vote that cities of that state operating under home-rule charters may regulate the rates of public-service companies. The cities affected are Denver, Colorado Springs, Pueblo, Boulder, Grand Junction and Fort Collins.

Good Roads Pay for Themselves Twice Every Year

Statistics for Three Roads in Los Angeles County, California, Show Large Operative Income From Decreased Haulage Cost

By John C. Veenhuyzen
Superintendent, Los Angeles County Road Department, Los Angeles, Calif.

COMPARISON of accurate traffic censuses with haulage contract prices over both improved and unimproved roads in Los Angeles County, California, shows highway improvement to be a great economic investment. According to the data available as to the saving in haulage per ton-mile, to date three of the main roads out of Los Angeles have paid for their original cost and maintenance about nine times during the past four years. While it is impossible to estimate some of the indirect saving and other advantages from such improvement, the actual saving in transportation amply justifies large expenditures for this purpose, and it is believed that if such figures as are here presented are made public, there will be no trouble in obtaining money for such construction.

Traffic necessarily requires good roads. On the other hand, good roads stimulate traffic, and it becomes a continuous battle to keep roads up to the condition required not only by the increased number, but also by the increased weight of vehicles. The better the road, the easier it becomes to haul heavy loads. Building good roads and maintaining them continuously in good condition is therefore expensive.

Public Does Not Realize Benefit

In general, the public is most interested in the original cost of such improvements, and although to a certain extent it is realized that they are a benefit to the community, still the public does not fully realize what the actual benefit is because there are no figures at hand to show this benefit in a form that can be grasped generally. Indeed, it is doubted whether the persons most interested in the subject—that is, those who create the traffic by the use of such roads for their daily work or pleasure—fully realize the economy which is the result of the improvement and to what extent they profit.

It will therefore not be out of place to give some detailed figures, the result of nearly five years of investigation, which express what might be called the "operative income" of good roads, i.e., roads which have been improved either by the application of a macadam or better surface. As an illustration, the discussion will be confined to three important roads, two connecting the City of Los Angeles with San Pedro and Long Beach harbors, and one connecting the Cities of Long Beach and Pomona. All of these roads are built of oiled macadam, and their cost of construction and maintenance, up to date, is given in the accompanying table.

The operative income on these roads was computed on the following basis: The cost of haul per ton-mile over unimproved roads, according to the records of the Los Angeles County road department, averages about 25c. The records also show that the average cost per ton-mile over roads improved as stated above is 10c. per ton-mile, and several contracts for hauling have been let on the latter basis. These figures are assumed to cover

INVESTMENT AND OPERATIVE INCOME FROM THREE ROADS IN LOS ANGELES COUNTY, CALIFORNIA

Harbor Boulevard (Built, 1912; length, 11.33 miles; cost, $231,185; upkeep, $133,249; total cost to date, $364,434.)

	Ton-Miles — Horse Traffic	Ton-Miles — Motor Truck Traffic	Operative Income at $0.15 per Ton-Mile	Miles Auto Traffic	Operative Income at $0.02 per Mile	Total Operative Income for Year
1915	2,278,634	2,689,771	$745,260.75	3,763,259	$75,265.18	$820,525.93
1916	628,588	2,832,765	517,703.00	5,231,354	104,627.08	622,330.08
1917	698,890	2,925,821	543,706.60	10,743,899	214,877.98	758,584.58
1918	326,675	3,421,086	562,164.10	14,647,763	292,955.26	855,119.36
Total						$3,056,559.95

Long Beach Boulevard (Built, 1911; length, 12.47 miles; cost, $183,151; up-keep, $241,231; total cost to date, $424,382.)

1915	791,959	1,376,843	$325,320.30	5,047,670	$100,953.40	$426,273.70
1916	223,026	2,344,030	385,058.40	7,419,026	148,380.52	533,438.92
1917	245,783	1,854,756	315,080.90	8,948,340	178,966.80	494,047.70
1918	300,505	3,038,159	500,799.60	15,853,045	317,060.90	817,859.50
Total						$2,271,619.82

El Monte-Pomona Road (Built, 1913; length, 19.39; cost, $256,465; up-keep, $146,863; total cost to date, $403,328.)

1915	3,036,183	3,414,821	$967,650.65	11,047,743	$220,954.86	$1,188,605.51
1916	4,090,718	3,556,368	1,147,062.98	13,227,567	264,551.34	1,411,614.32
1917	4,090,718	3,556,368	1,147,062.98	13,227,567	264,551.34	1,411,614.32
1918	820,972	5,891,893	1,006,929.96	18,585,121	371,702.42	1,378,632.38
Total						$5,390,466.53

only the actual hauling and not the cost of loading and unloading trucks at freight terminals. This shows an operative income of 15c. per ton-mile on improved roads for commercial hauling. Why these ton-mile charges are lower than those reported from other parts of the country is not known, but it is suggested that it is due to lower wages and practically a 100 per cent year—that is, it is possible to operate trucks every day in the year with no interference from snow and ice and little from rain. Naturally, under these conditions upkeep is very much reduced and there is little lost time. In arriving at the figures the operation cost of the county-owned trucks were taken into consideration, depreciation being allowed at 20% per year.

The foregoing figures for the saving in commercial haulage were obtained from the difference in actual contract prices, but the saving for passenger automobiles, while not so easy to determine can also be considered an income. This income is made up of many factors, such as saving in oil, gasoline, wear and tear, and time. The saving from this source was assumed for automobiles at 2c. per mile. On distances as shown for the three roads in the table a saving in time of one-half in coming and going computed at 50c. an hour will more than cover this assumed total saving in operative income.

Accurate traffic censuses which were used in computing the figures in the table were taken on the three roads as follows: The figures showing average daily tonnage and number of vehicles were computed from a census of seven consecutive days of 24 hours each, and are as complete and correct as they can be made. They were not picked at random but were taken in shifts by experienced men and in different months during the year. The standards accepted for weights are rather low, so as to obtain only conservative figures.

The figures given for operative income in the tables were computed on the assumption that the traffic of each year was constant, and neglecting the steady increase of traffic during the year. It will be seen that in the case of the Harbor Road the income for four years was about 8½ times the total cost plus the maintenance; for the Long Beach Boulevard the income was 5½ times the cost, while for the El Monte-Pomona Road the income exceeded the total cost about 13 times.

There was no way of measuring the local traffic between intermediate points on these roads, so that the figures only show the actual traffic coming from and going to the City of Los Angeles, and passing over the entire length of the roads. They are therefore conservative and show the great financial gain to the public resulting from road improvements. The benefits of these gains are not necessarily confined to those who are making use of the roads, but they react on the public in general, especially through improved marketing conditions for garden truck, fruit, and dairy products. Aside from this, there are the many advantages of pleasure, convenience and comfort which such roads give to the users.

Considering the fact that these roads were built from a bond issue of $3,500,000 and form only a small part of the Los Angeles County system which was built under the issue, the road improvements from a financial standpoint cannot be criticised.

Covered Wooden Highway Bridges Economical in Oregon

MANY timber highway bridges have been built by the bridge department of the Oregon State Highway Commission, as noted in the annual report of the latter for 1917-18, because the material for such structures is plentiful in that state, and the first cost and maintenance charges are sufficiently low to warrant their consideration from the standpoint of economy. Observation of existing structures leads to the conclusion that the life of uncovered bridges is about 10 to 15 years, and that when they are properly covered the increased life is from 30 to 40 years. The covering of a wooden truss span adds about 30% to the cost and over 50% to the life of the structure.

One of the main disadvantages of the covered wooden truss span—that is, the bad lighting conditions—has been overcome by introducing a pleasing design of cased window openings. These open windows, however, can only be used when the bridge floor is paved. Otherwise, the advantage of the covered type is lost, due to the fact that the rain blows in and reaches the structural members.

The foregoing information has been furnished by C. B. McCullough, bridge engineer of the Oregon State Highway Commission, Salem.

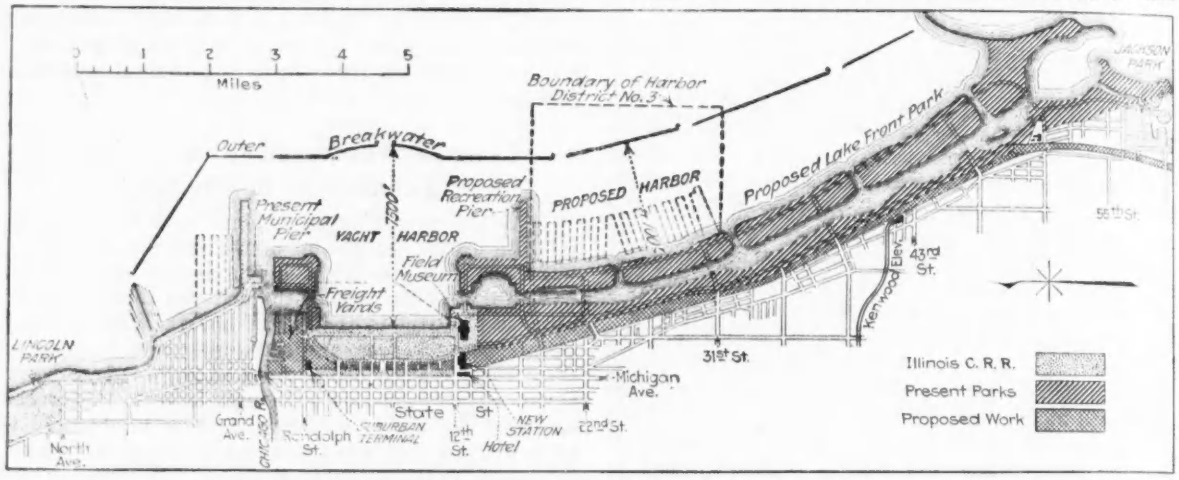
Australia Has New Large Irrigation Projects

Near Albury, N. S. W., there has just been started an irrigation project which will, when completed, have a reservoir capacity of 1,000,000 acre-feet and a reservoir area of 30,300 acres, which brings it up among the large irrigation projects of the world. The site of the main dam is on the Murray River, and the reservoir extends into Victoria. About $8,000,000 will be expended by the Governments of New South Wales, South Australia, Victoria and the Commonwealth of Australia. The main dam is 3601 ft. long, divided into a 2700-ft. earth section, a 740-ft. concrete spillway and a 1061-ft. outlet works. It is not very high, being only about 85 ft. at the deepest part of the river. The discharge over the dam will amount to about 100,000 cu.ft. per sec., and a portion of this is to be utilized for hydro-electric development. Other parts of the work comprise an irrigation canal, control of the Murray River by locks and dams, and future control of other nearby rivers.

Chicago's $140,000,000 Lake-Front Improvement Plans

Railway Terminals, New Station, Electrification, Park, Harbor, Stadium and Other Large Developments Included

INTRODUCTION of electric traction on the Chicago terminal lines of the Illinois Central R. R., and reconstruction of the passenger terminal on a greatly enlarged scale, have been brought several steps nearer to attainment by the passage July 21, 1919, of a city ordinance covering this work and the general improvement of the lake front as a city park. The railway and park works are closely interlocked, owing to the fact that the railway occupies a part of the present shore line, beyond which it is proposed to establish a lake-front park by filling in along the shore, thus connecting Grant and Lincoln Parks on the north with Jackson Park on the south.



MAP SHOWING LAKE-FRONT AND RAILWAY IMPROVEMENTS FOR CHICAGO

Complications of right-of-way, riparian rights, specific improvements, conflicting interests, encroachments on navigable waters and means of access across the railway to the park and harbor together with various allied matters of major or minor importance, have caused the negotiations to take the form of a four-sided debate between the city of Chicago, the South Park Commission (a state authority), the railway company and the United States Government (War Department). The filling on the lake front cannot be done without permission of the War Department. This it has refused to give until definite plans were presented, and it has also required that provision must be made for a lake-front harbor development within this park area. With these main elements and innumerable other matters to be harmonized and brought into a comprehensive but reasonable ordinance, the negotiations have progressed intermittently for over 15 years, but during the past few months they have been speeded up considerably. The ordinance, when approved by the mayor, will be submitted to the War Department.

Electrification of the Illinois Central Railroad lines within the city limits is one of the most important and interesting features of the improvement. This is to be applied to the suburban service within seven years, to the freight service with 10 and 15 years for different sections, and to the passenger service within 20 years. These provisions apply also to the Michigan Central R.R. and to some local lines of the Illinois Central Railroad.

The new passenger station is to front on 12th St., east of Indiana Ave., and its building is to be of a classic design, harmonizing with the new Field Museum, which is closely adjacent. This building will be 420x150 ft., with provision for extending it laterally in both directions as traffic develops. The main tracks will be elevated, but 12th St. will be raised also by an incline so as to be at the level of the main floor of the station. Beneath this level will be the baggage and express floor, approximately at normal street level, beneath which, again, will be the thorough suburban tracks. The plans provide for a future lower deck beneath the baggage-room level, thus doubling the track space. The station plans were presented some time ago (see *Engineering News* of Sept. 28, 1916, p. 624, and *Engineering Record* of Dec. 23, 1916, p. 783.)

It will be a terminal station for main-line trains, with 12 stub tracks at the first-floor level, but there is ample room for increasing this number to 25 when required, independently of the lower-track deck already noted. Four suburban tracks will be depressed to pass under the station and continue north to the local terminal at Randolph St. Three freight tracks will pass outside the east end of the station and continue to the freight yards at the Chicago River. These suburban and freight tracks will extend through Grant Park, in the present open cut with concrete retaining walls, but at a lower level. Coach yards, a local freight yard and an engine terminal with rectangular engine houses are to be arranged south of the station. Improvements included in the park work are a stadium to seat 100,000 and a large aquarium. The cost is estimated at $88,500,000 for railway work and $53,000,000 for park work, the city's share of this latter being about $750,000.

Favors Municipal Ownership

Acting on a recommendation of its charter revision committee, the city council of Atlanta, Ga., has adopted a resolution asking the legislature to pass a charter amendment authorizing the city to acquire and operate any public utilities in Atlanta now owned by private corporations.

Some Tests on the Properties of Reinforced Concrete

Effect of Protecting Metal, Lapping Reinforcing Bars and of Reversing Stress in Beams as Well as the Action of Diagonally Placed Rods in Slab Spans Studied for Concrete Ship

By W. A. Slater

United States Bureau of Standards, With Emergency Fleet Corporation, Philadelphia, Penn.

Elaborate investigations of the availability of concrete for ships were necessarily a part of the program of the concrete ship section of the Emergency Fleet Corporation in preparation for its work during the war. The studies then made involved many kinds of laboratory tests which it may be impracticable to publish in full, but some of the results having most applicability to reinforced concrete in general are now being made public. Such results were the subject of a paper by W. A. Slater, who had charge of the investigations, in a paper entitled, "Structural Laboratory Investigations ip Reinforced Concrete Made by Concrete Ship Section, Emergency Fleet Corporation," and presented to the annual convention of the American Concrete Institute. An abstract of some of the data in that paper is given here.

Corrosion Tests

A CORROSION investigation was begun with the idea of determining the relative value of various kinds of coating which might be used for the purpose of protecting steel embedded in concrete from corroding due to the action of sea water and of sea air. Proprietary paints and bituminous coatings were used for the most part in this investigation. In addition, certain metallic coatings were used. Because the results were needed at the earliest possible date, the salt-spray accelerated test was applied. No way is apparent of converting the length of time which specimens stood up under this severe test into actual time which they would stand up under service conditions. However, the results may be expected to show something of the value, relatively to each other, of various means of reducing corrosion. The various specimens consisted of 4 x 4-in. pieces of black iron of No. 16 gage coated with the material to be used as a protective covering. In the case of paints and bituminous coatings the specimens were allowed to harden as much as they would without long-continued exposure. This generally required from 5 to 15 days.

As a result of the salt-spray tests it was found that any one of several different kinds of paints or bituminous coatings furnished a high degree of protection against corrosion. Their suitability for use depends on the practicability of applying a coating, of placing a coated bar of this kind in position without damaging the protective coating, and upon the fact that in all cases the bond resistance is seriously affected by such a coating.

Galvanizing and sherardizing protected the steel against corrosion, but a decomposition of the zinc itself took place. This raised the question of whether the salt which forms in this decomposition would have the same effect in splitting the concrete away from the bar as occurs when the unprotected bars are used. Electrolytic tests, in which both galvanized and unprotected bars were used, showed that the galvanized bars split due to corrosion within a shorter time than did the unprotected bars. There was uncertainty, however, as to whether the same action would occur in corrosion which was not due to electrolysis.

A proprietary method of protecting steel from corrosion which involves a chemical action of a phosphorus compound on the steel was tried. This gave poorer resistance to corrosion than any of the paint or bituminous coatings. However, when compared with unprotected steel there was sufficient retardation of corrosion to indicate that this method of protection may have decided value for treatment of steel which is embedded in concrete, since it caused no apparent loss in bond resistance.

The results of the tests made were not sufficiently conclusive to warrant the adoption of any anti-corrosion treatment for the reinforcement in the concrete ships which are under way.

Leakage of Water Through Cracks

Early in the investigation of shearing strength of reinforced-concrete beams it was found that cracks were likely to form when shearing stresses were considerably lower than those which it seemed necessary to use in the design of concrete ships; yet it was not known whether these cracks were such as would permit leakage of water through them or not. Tests were made in which hollow beams were loaded in such a way as to cause diagonal tension cracks in the side walls at the same time that the beam was filled with water which was maintained under pressure varying in head from 15 to 30 ft. These tests indicated that the smallest crack which could be detected, say 0.001 in. or less, in width, would permit the passage of enough water to cause a moist surface on the outside around the crack. As the crack width increased, the leakage increased rapidly, provided that time was not given for the closing up of cracks by the deposit of sediment of any kind. When the crack was 0.01 in. wide, water spurted clear of the outer surface of the beam.

When the beam was allowed to stand over night with the pressure head and the load maintained, the leakage was decreased markedly. This was probably due to the deposit of a substance which helped to fill up the cracks. Further indication of this was shown by the appearance of efflorescence on the surface of the beam in the neighborhood of the cracks.

If the cracks had been very small at the time of their formation and had developed very slowly, it is possible that the silting would have kept up with the opening of the cracks, and that leakage would not have occurred. Apparently, this is what has happened with some of the concrete ships and barges which are afloat. An inspection made by the writer on a concrete ship which had been in the water about a year showed the presence of cracks which were large enough to cause leakage under the conditions to which these test beams were subjected. However, there was no leakage, although the cracks were below the water line, and apparently there had been none. There was efflorescence apparent at cracks on the inside of the hull, indicating that the process of silting had been taking place. To the writer this seems more nearly a conclusive demonstration of the ability of the concrete ship to stand up under the conditions of

service than would be the case if there were no cracks, and if the possibility of cracks yet forming were present, together with uncertainty as to whether they would close up due to formation of silt.

Bond Tests of Coated Bars

Bond tests were made to determine the effect of the various anticorrosion treatments on the bond resistance of a bar. These were pull-out tests in which the specimens consisted of 6 x 6-in. concrete cylinders with ½-in. square bars, both plain and deformed, embedded axially in the cylinder. The amount of slip was measured accurately. The results of these tests indicate that in general all protective treatments used, except the phosphate treatment, reduced the bond resistance materially. This statement is true, regardless of whether plain bars or deformed were used, and regardless of the amount of slip which is to be taken as the basis for comparison.

Bond Tests with Lapped Bars

Beams were made in which a ½-in. bar was lapped over a distance of 40 in. at the center of the span. In one beam no other bars were present. In all others six additional bars varying in size from ½ in. to ¾ in. were used. Measurements of stress were taken at various points along the lapped bar as well as along the through bars, as shown in Fig. 1. Bond resistance was probably slightly decreased by the notches which were required to expose the bars for measurement.

In judging of proper working stresses in bond, an end slip of 0.01 in. in pull-out tests has sometimes been used

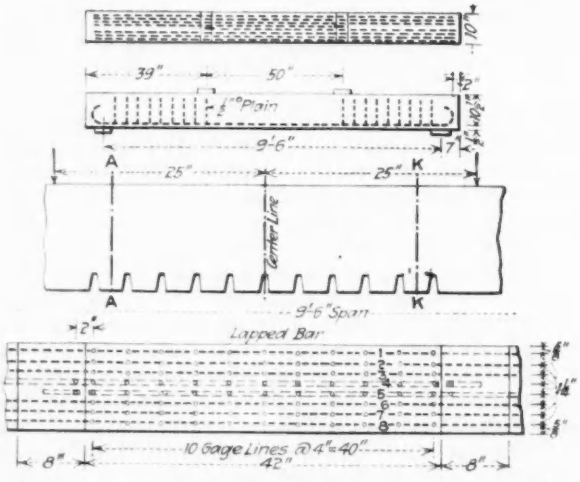


FIG. 1. TEST BEAM TO DETERMINE LENGTH OF LAP OF REINFORCING BARS

as the criterion. For pull-out tests using a concrete not less strong than that in these tests the bond resistance for uncoated bars at 0.01 in. end slip was 600 lb. per sq.in. The results of this test indicate that the factor of safety for unanchored bars is less than would appear if the working bond stress is based upon the resistance when the end slip is 0.01 in.

Fig. 2 shows the load-stress graphs for all the bars of beam 8AAB1 at sections A and K. Bars 4 and 5 were lapped with bar 5 ending near section A, and 4 ending near K. At section A, bar No. 5 was of little use in resisting the bending moment but it increased in effectiveness from section to section until at section K it

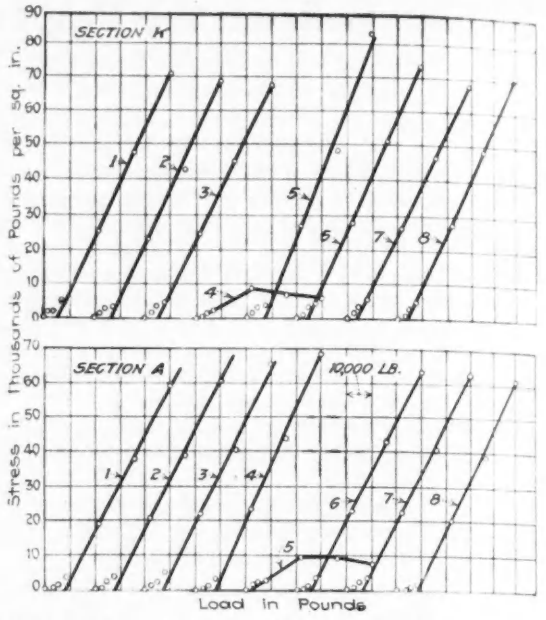


FIG. 2. LOAD-STRESS GRAPHS AT EXTREME ENDS OF ONE OF THE TEST BEAMS SHOWN IN FIG. 1

was fully as effective as any bar in the beam. Likewise, bar No. 4 was ineffective at section K, but at section A was fully effective.

The distribution of the stresses along the bar is shown in Fig. 3 for beam 8AAB1. The solid lines show the stresses in the lapped bars and the dotted lines

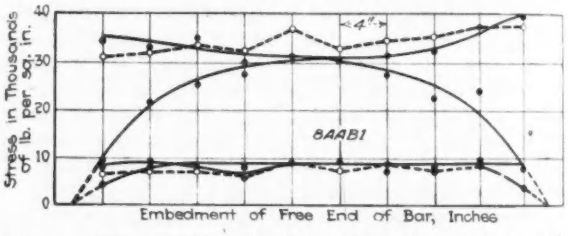


FIG. 3. DISTRIBUTION OF TENSILE STRESS ALONG RODS FOR TWO LOADS

Solid lines = stresses in lapped bars; dotted lines = stresses in through-bars

show the average for all other bars in the beam. The curves are given for two different loads for each beam. These loads are those which will give computed tensile stresses of 16,000 and 40,000 lb. per sq.in. in the reinforcement. From the slopes of these curves the bond stresses may be determined. These are shown in Fig. 4 for beam 8AAB1 for loads of 22,000 and 36,000 lb. The distribution of points on curves for Figs. 3 and 4 is somewhat erratic, due to the formation of cracks which will cause tensile stresses and bond stresses to be set up which are not in accordance with the assumption of perfect bond resistance. The amount of slip for beam 8AAB1 at various points along the reinforcing bars is shown in Fig. 5 for loads of 22,000 and 36,000 lb. The greater regularity for these points is due to the fact that they represent the summation of deformations along a bar. By this process of summation the irregularities due to cracks are removed to a great extent.

To serve as a working basis it may be assumed that for any given tensile stress the safe length of lap is

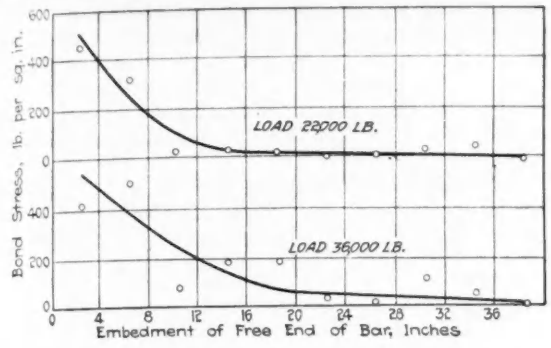


FIG. 4. DISTRIBUTION OF BOND STRESS ALONG BARS OF BEAM

the distance from the free end of the bar to the point where the tensile stress in the lapped bar becomes constant and equal to the stress in an adjacent through-bar. Analysis shows that if the lap furnished is less

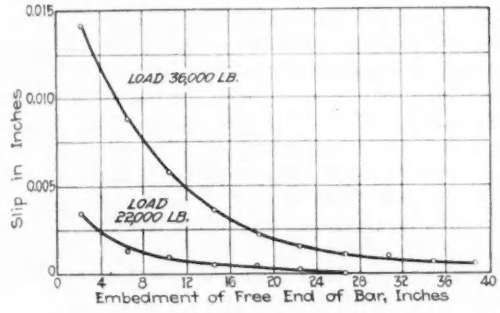


FIG. 5. SLIP AT SUCCESSIVE POINTS ALONG BARS OF BEAM

than this the tensile stresses in the through-bars at the ends of the lap will be greater than the value computed by the equation:

$$f_s = M/A_s jd$$

This is based on the assumption that the entire lap lies within a region of constant bending moment.

With this assumption as a basis, Fig. 6 has been prepared. The data for the beam without any through-bars were not used in this figure. The amount of reinforcement for this beam was very small; consequently, the concrete took a large portion of the stress, and the stress curves for the steel were too erratic for use in this way. The ordinates of the points given represent the distance from the ends of the lapped bars at which the measured stresses shown as abscissas were developed. A straight line represents fairly well the mean of the values shown by the points. The equation of this line is:

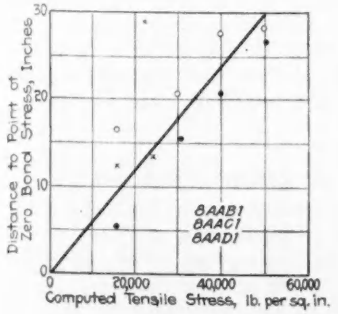


FIG. 6. RELATION OF TENSILE STRESS IN REINFORCEMENT TO LENGTH OF LAP REQUIRED

$$s = .00059\, f_s \text{ where} \quad (1)$$

s = distance in inches from end of lapped bar to point where bond stress becomes zero, and

f_s = the tensile unit stress under consideration.

It is apparent that the total tensile stress in a lapped bar at the section where the bond stress becomes zero is:

$$\frac{\pi a^2 f_s}{4} = \pi a u s, \text{ where} \quad (2)$$

a = diameter of bar, and

u = average bond stress in distance s.

From this equation

$$f_s = \frac{4\,us}{a} \quad (3)$$

Substituting in equation (1)

$$= .00059\,\frac{4\,us}{a} \quad (4)$$

$$u = \frac{a}{4 \times .00059} = 210 \text{ lb. per sq. in.} \quad (5)$$

This indicates that the value of the average bond stress was independent of the tensile stress developed. The adoption of this form of equation is equivalent to concluding that the average bond stress over the length s was the same at all stages of the test, but that the length s increased as the tensile stress increased. Reference to the beam in Fig. 4 shows that the distance s from the end of the bar at which the bond stress becomes zero was greater for the load of 36,000 lb. than for the load of 22,000 lb. but that the average bond stress was not far from 210 lb. per sq.in. in both cases. For the other beams the average bond stress was less than this. It probably is not exactly true that the average bond stress developed at the ends of lapped bars is independent of the tensile stress developed, but as a basis for design this assumption is probably exact enough.

It is generally assumed that the length of embedment required to develop the tensile strength of the bar is directly proportional to the diameter of the bar. In this investigation it was not feasible to test a sufficient number of beams with lapped bars to check this, but it seems a logical assumption to make. In these tests ½-in. bars were used. That is

$$a = \tfrac{1}{2} \quad (6)$$

Dividing equation (1) by equation (6) gives an equation for the number of diameters of lap required to develop the stress f_s.

$$\frac{s}{a} = \frac{.00059\, f_s}{\frac{1}{2}} = .00118\, f_s \quad (7)$$

The stress in the lapped bar just outside the lap is the f_s of this equation. If this is less than the average stress at this section calculated by the equation

$$f_s = \frac{M}{A_s\, jd}$$

the stress in the through-bars must be greater. Consequently, in using this equation to state the safe length of lap, the value of f_s should be the yield-point stress. Otherwise, the yield-point stress will be passed in the through-bars before reaching it in the lapped bars. Putting the yield-point stress at 40,000 lb. per sq.in.

$$\frac{s}{a} = 0.00118 \times 40{,}000 \quad (8)$$

$$s = 47.2a \quad (9)$$

The concrete in these beams had a compressive strength (determined from cylinder tests) of about 5,000 lb. per. sq.in. and for leaner concrete it is to be expected that a greater lap would be required.

This may seem a large requirement for the lap, in view of the fact that an embedment of 40 diameters is generally supposed to be sufficient to develop the full strength of a bar even with a leaner concrete than that used here. However, it must be remembered that this opinion is based generally upon pull-out tests of specimens which have no tension in the concrete surrounding the bar. In a region of high tensile stress considerable cracking of the concrete may occur. This tends to destroy bond resistance and a greater length of embedment would be expected to be necessary.

Furthermore, as pointed out in a previous paragraph, there were indications that in beam 8AAD1 there was some slip over the entire length of the bars, although the bond stress developed was only 270 lb. per sq.in.

Reversal of Stress

One of the earliest questions to arise in connection with design of reinforced-concrete ships was that of the deterioration of concrete due to a grinding and abrasion of the fractured surface of concrete on the tension side of a structure subjected to reversal of stress. Tests were made on concrete beams of a 1:2 mix to ascertain how serious this action might prove to be. The beams were 6 in. wide, 8 in. deep, and 8 ft. long, reinforced longitudinally in the top and in the bottom. They were subjected to reversal of loading at the rate of about seventeen cycles (17 loads up and 17 loads down) of loading per minute. At the present time, only four specimens have been tested to failure. Of these all have failed by tension in the reinforcement at a much smaller number of applications of load than is generally expected for tests of steel. There are a number of features of the test which may be considered partial explanations of the failure but none of them are entirely satisfactory.

In one beam, which had 1¼-in. bars without mechanical anchorage, less than 0.001 in. slip could be detected within the first 7200 applications of load. At this point slipping began and increased in amount until at 400,000 applications the slip was more than 0.06 inch.

One of the beams was made I-shaped in cross-section in order to introduce high shearing stresses. This beam proved to be very tough. The web reinforcement consisted of vertical stirrups spaced 2 in. apart welded to the reinforcing bars at the top and at the bottom.

The grinding of the fractured surfaces of the concrete was found to be negligible within the range of tests completed. In one of the beams after about 600,000 applications of stresses of 1550 lb. per sq.in. in compression in the concrete and 20,000 lb. per sq.in. tension in the steel, there was a slight indication of grinding and abrasion of the fractured surface, but other circumstances connected with the test indicated that this condition was only at the surface of the beam and did not extend to its interior. The stress observations indicated that throughout the test the beam was acting normally and that abrasion of the fractured surfaces did not affect in any way the amount of resistance afforded by the concrete to the compressive stresses in the beam.

For a beam subjected to 2,000,000 applications of a load which caused measured deformations corresponding to tensile stress in the reinforcement of 11,000 lb. per sq.in. and a compressive stress in the concrete of about 1450 lb. per sq.in., the largest crack measured 0.003 in. For this beam no indication is present of any grinding action between the fractured surfaces of the concrete and there is nothing to indicate that the beam is approaching failure.

These tests have developed failures which are difficult to explain but which point out the importance of careful inspection of reinforcement for a structure which has to undergo frequent repetition of stress.

Effect of Direction of Slab Bars on Stresses

In the design of reinforced-concrete slabs it has generally been assumed that where the reinforcing bars make an angle with the direction of span the stress developed in the bar is equal to the product of the stress which would be developed if the bars were in the direction of the span, and the secant of the angle which they make with the span. The writer knows of no previous tests which give information on this subject.

Slabs were designed in which the reinforcing bars made an angle of 45° with the direction of the span, and for comparison with them slabs were made with the reinforcing bars placed in the direction of the span. The results indicated a stress in the slabs with bars at 45° about 20 to 25 per cent greater than in the case where the bars were parallel with the direction of span. With the number of tests available it seems best to interpret the results as meaning that the ordinary method of design is satisfactory though conservative, rather than that standards may be changed to permit greater advantage to the bars placed in the diagonal direction than is now accorded them.

In this investigation specimens reinforced with expanded metal were also included. These slabs show measured stresses in the reinforcement slightly less than the stresses in the slab in which the same weight of steel was used in the form of bars placed in the direction of the span. Although this would indicate that expanded metal is more effective in resisting tension than the same amount of metal would be if used in the form of bars extending in the direction of the stresses to be resisted, the tests have not been extensive enough to warrant so sweeping a conclusion. The showing is favorable to expanded metal, so far as economy of material is concerned, but more tests using deeper slabs should be made before this question is considered to be settled. The slabs used were so shallow that a small variation in depth would result in a relatively large variation in stress developed.

Swiss Railways To Extend Electrification

Extension of the electrified section of the Federal Rys. of Switzerland has been decided upon, and the board of direction has made an appropriation of 43,500,000 francs to provide for 141 km. of improvement. As reported in the *Schweizerische Bauzeitung* of May 10, 1919, the sections of railway involved are from Erstfeld to Luzern, from Arth to Zürich, from Luzern to Zug, and from Immensee to Rothkreuz. Extension from Rothkreuz to Olten will be considered in the near future. An additional sum of 37,500,000 francs has been appropriated for a hydraulic power-plant at Barberine, which is to furnish power to the western section of the railway network.

Computation of Lengths of Elliptic Arcs

By George Paaswell
New York City

IN THE design and computation of circular shafts, tunnels, pipes, etc., involving sections taken at an angle with the right section, it becomes necessary to determine the lengths of elliptic arcs. The addition of small miscellaneous structures to such shafts, such as pump chambers, manholes, inspection galleries and the like, requires special concrete and steel detailing, and also often makes it necessary to find the length of some elliptic arc. Again, a shaft may be given a true elliptic periphery for special reasons; for example, a vertical shaft of circular interior carried two steel columns supporting a steel structure, and in order to increase the supporting width the outside periphery of the shaft was made elliptical, the columns lying on the line of the major axis.

The following analysis simplifies the work of computing elliptic arcs, and tables are given to aid in the application of the equations derived.

The length of the elliptic arc, unlike that of the circular arc, cannot be expressed in terms of the elementary transcendental functions. The equation of the ellipse, in rectilinear coördinates, referred to its center as origin, is,

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \qquad (1)$$

in which a and b are the semi-major and semi-minor axes, respectively.

The length of the arc between any two abscissas, x_1 and x_2, is

$$s = \int_{x_1}^{x_2} \sqrt{1 + \left(\frac{\mathrm{d}\,y}{\mathrm{d}\,x}\right)^2}\,\mathrm{d}\,x \qquad (2)$$

If in (1) $y = b \cos \phi$; $x = a \sin \phi$ and the eccentricity of the ellipse, i. e., $a^2 - b^2/a$ is placed equal to k, the length of the arc becomes

$$s = a \int_{\varphi_1}^{\varphi_2} \sqrt{1 - k^2 \sin^2 \varphi}\,\mathrm{d}\,\varphi \qquad (3)$$

placing the integral $\int_{o}^{\varphi} \sqrt{1 - k^2 \sin^2 \varphi}\,\mathrm{d}\,\varphi = E(\varphi)$

The integral in (3) becomes the difference of two arcs and the expression may be written

$$s = a[E(\varphi_1) - E(\varphi_2)] \qquad (4)$$

Table I gives a series of values of $E(\phi)$ for the several values of the ratio b/a, and of the ratio x/a.

To use the table to determine the length of any arc of a given ellipse, the ratio b/a is first found. Then entering the proper column corresponding to this value (interpolating if necessary) and using the values of x_1/a and x_2/a the proper values of $E(\phi)$ for Eq. 4 are found, whence that equation gives the required length.

The length of an elliptic quadrant is given by

$$s = a \int_{o}^{\pi/2} \sqrt{1 - k^2 \sin^2 \varphi}\,\mathrm{d}\,\varphi$$

and if this integral is replaced by F, the complete perimeter of the ellipse is

$$s = 4\,a\,F$$

Table II gives the values of F for several values of the ratio b/a, and intermediate values can be obtained by interpolation.

TABLE I—VALUES OF $E(\varphi)$

x/a \ b/a	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95	1.0
0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.1	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
0.2	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.201
0.3	0.300	0.300	0.300	0.300	0.301	0.301	0.302	0.303	0.303	0.304	0.304	0.305
0.4	0.400	0.400	0.400	0.401	0.402	0.403	0.404	0.406	0.408	0.409	0.410	0.412
0.5	0.500	0.500	0.501	0.502	0.504	0.506	0.509	0.512	0.515	0.519	0.522	0.524
0.6	0.600	0.601	0.603	0.605	0.608	0.612	0.618	0.624	0.629	0.637	0.640	0.644
0.7	0.700	0.701	0.704	0.708	0.713	0.721	0.730	0.740	0.749	0.763	0.769	0.775
0.8	0.800	0.801	0.807	0.814	0.822	0.836	0.850	0.867	0.886	0.906	0.917	0.927
0.9	0.900	0.903	0.912	0.925	0.943	0.965	0.990	1.020	1.052	1.085	1.105	1.120
0.95	0.950	0.954	0.970	0.987	1.014	1.044	1.081	1.118	1.159	1.205	1.230	1.253
1.0	1.000	1.016	1.050	1.097	1.150	1.211	1.276	1.346	1.418	1.492	1.532	1.571

TABLE II—VALUES OF F

b/a	F	b/a	F
0.00	1.000	0.55	1.242
0.05	1.005	0.60	1.276
0.10	1.016	0.65	1.310
0.15	1.032	0.70	1.346
0.20	1.050	0.75	1.380
0.25	1.073	0.80	1.418
0.30	1.097	0.85	1.455
0.35	1.123	0.90	1.492
0.40	1.150	0.95	1.532
0.45	1.176	1.00	1.571
0.50	1.211		

Narrow Gage Recommended for Local Railways in France

LOCAL or light traffic railways built and rebuilt in France after the war, particularly those in the devastated regions, should have meter-gage tracks but with ample provision of special cars for carrying standard-gage freight cars in order to avoid transfer of freight. These are the general conclusions presented in a paper on "Local Railways After the War," by M. Claise, in the *Annales des Ponts et Chaussées*, Paris, January-February, 1919. Exceptions might be made for short lines of easy construction connecting two standard-gage lines and carrying a considerable traffic of fully loaded cars.

In his opinion the cost of construction of standard-gage railways will be relatively very high at the prices that will prevail during the next few years, while operating costs also will be high. Furthermore, such lines require rails of 50 lb. per yard, as against 40 lb. for meter-gage lines, while cross-ties aggregate nearly twice the cubic contents of those for the latter lines. Reconstruction of the ruined narrow-gage railways as standard-gage lines would involve considerable additional earthwork in widening the roadbed and easing the curves, while such work would delay putting the lines in operation.

Transfer of freight at points of break of gage would be a serious inconvenience, but can be eliminated readily by the use of transporter cars to carry the standard-gage equipment. In both new construction and reconstruction of the meter-gage lines, therefore, it is suggested that care should be taken to provide ample clearance for main-line or standard-gage cars. In the system used on the Lake Brienz Railway, the transporters are double-truck cars having steel channel sills outside of the wheels, with their tops only 22 in. above the rails. These form a track for the wheels of a standard-gage car. At the transfer point, the standard-gage and narrow-gage lines have stub ends on the same center line, but with the latter track at a lower level so that the sills of the transporter are level with the rails of the standard-gage line.

Handling Materials in Construction of New York Hotels

New Type of Hoisting Bucket Used During Erection Prevents Excessive Vibration of Steel Frame—Comparison of Costs

SAVING both in labor and time is reported by the building superintendents of construction on the Hotels Commodore and Pennsylvania, New York City, through the use of a new hoisting bucket for mixed concrete and concrete materials. The advantage of the bucket over the old platform hoist using wheelbarrows is estimated in terms of costs. Being centrally loaded and having a bottom dumping arrangement, the bucket causes no vibrations to unriveted steel structures such as caused trouble with the older top dumping type. During the past season, when labor was scarce, this hoist was of especial value on account of its speed, and it was possible to eliminate many hoisting outfits on these buildings.

The general arrangements for handling material were about the same as usual for structures of this size. Sand, crushed stone and cinders were delivered at the ground level by motor trucks and dumped into concrete-mixing pits below the ground-floor level. The towers for the hoist guides were carried from the sub-basement up through the courts or outside of the buildings, to make unnecesssary the usual openings in the floors. The mixed concrete was dumped and chuted into the buildings through the windows. Arrangements were made so that the concrete aggregates could be run by gravity into the concrete mixer and from the concrete mixer into a supply hopper which was used to fill the hoist buckets. Electric motors of 50 hp. were used for operating the hoists. Steel cable of ⅝-in. diameter and double-line, running over a 16-in. single sheave on the tower, was used to raise the 1-cu.yd.-capacity bucket.

One of the features of this new hoisting apparatus is that smaller towers may be used, and very little bracing or guying is necessary. This is due to the fact that the load is always centrally suspended, and the bucket is bottom dumped instead of being tipped by means of throw-out guide rails at fixed points on the tower. When the top dumping type of bucket is tipped there is necessarily considerable vibration in the tower. With the arrangement described, it is possible to run a tower as high as 50 ft. without using guys to steady it.

Material may be chuted to several floors at the same time, without the necessity of changing throw-out guides from one to the other. Fig. 1 shows a tower with several dumping chutes projecting through the windows. In cases where it is inconvenient to chute directly into a floor, materials may be chuted to the floor above, through an opening into another hopper, as shown. A special hopper is used for this work; it will be described later.

A close-up view of the hoisting bucket, known as the Gardner hoist, is shown in Fig. 2. The method of operation will be readily seen. It is equipped with a skip, 3, which is thrown forward to bridge the clearance space between the bucket and the chutes. The normal position of the levers for a closed bucket in hoisting is for both to be thrown forward toward the dumping side. In the view the skip is thrown forward ready for dumping. Lever 1 is pulled back as shown to throw the skip forward, while lever 2 releases the side of the bucket, which is hinged at 4. When the bucket arrives at the dumping point the attendant first throws the skip forward and then releases the hinged door, which is forced open by the weight of the material, allowing the concrete to slide out into the chute.

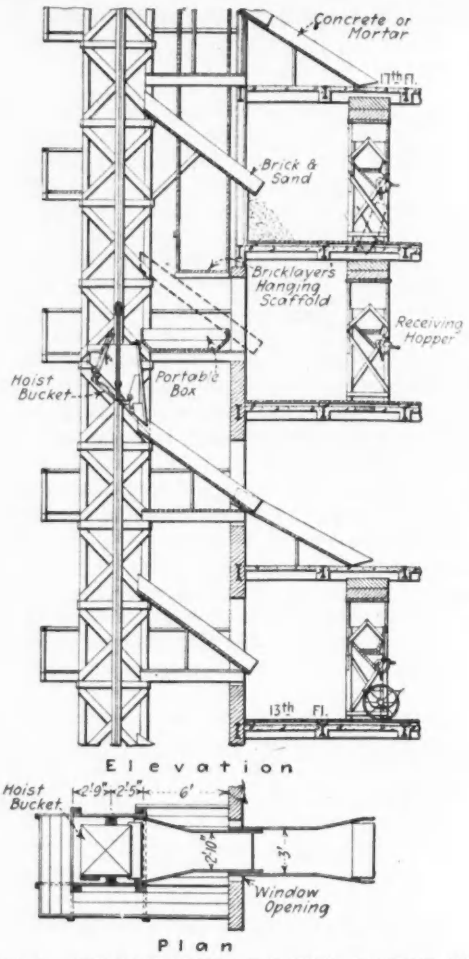


FIG. 1. ARRANGEMENT OF TOWER, BUCKET AND HOPPERS

In connection with this bucket, a receiving hopper, as shown in Fig. 3, is generally used. This allows for continuous operation of the bucket, the hopper having enough capacity to take care of the fluctuations in carrying to place. It is arranged to handle all the consistencies of mixtures ordinarily used in building-construction work, and has a special device to overcome binding of the gate by material. To operate, handle 1 is first raised, revolving an eccentric and throwing the gate forward and free from contact with the material. When handle 1 hits handle 2 a continuous

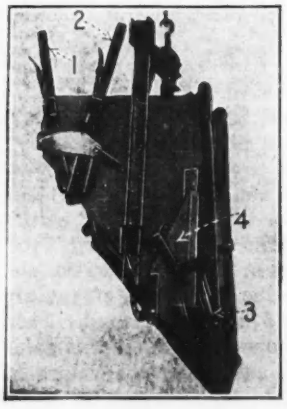


FIG. 2. SPECIAL BUCKET

movement occurs, raising the gate and allowing the material to flow out. There are two wings at 3 in the outlet which restrict it to about half the outside diameter shown.

The tower and the guides for this hoisting outfit are so arranged that it may be readily replaced with a platform hoist for any special purpose. To make the shift, it is only necessary to lower the bucket to the bottom of the shaft, take out a section of the guide rail, slip in the platform hoist and rebolt the guide. This change can be made in about 20 minutes.

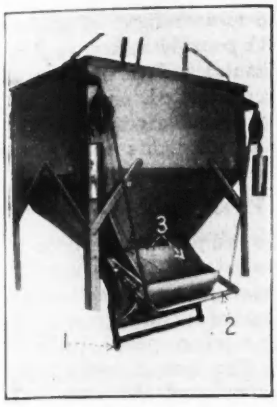


FIG. 3. DETAILS OF SPECIAL HOPPER

Not only will the bucket handle concreting materials, but dry material such as rubbish may be removed from the various floors and chuted into a rubbish bin to be carried away. Economical handling of rubbish is considered one of its main features.

Another large saving is in the lumber used. Not only are fewer towers required, but there is much less lumber in each tower, particularly because the platforms at each floor of the platform type of hoist must go entirely around the tower.

In elevating materials with a platform hoist as now employed in building construction about New York, two wheelbarrows are carried at each trip. Each barrow holds 2 cu.ft. of wet materials or 3 cu.ft. of dry or cinder concrete, making 4 or 6 cu.ft. to each lift. This system requires five men each at the top and bottom of the tower, two men to put on loaded and empty barrows, two men removing loaded and empty barrows, and one bell ringer, or ten men to load on and carry off. These men are standing waiting much of the time. With the new bucket two men are required for the operation of hoisting—one man to dump materials in the receiving hopper by operating the levers as described above, and one man to load the pushcarts or wheelbarrows at the upper-floor receiving hopper. With the 1-yd. bucket, two men can hoist 30 cu.ft. to a lift.

Comparing the relative economy of using Gardner buckets and platform hoists, the following information was obtained from Robert E. Carrick, secretary-treasurer of the Fireproof Contractors' Corporation of New York City, which put the fireproofing into the Hotel Commodore.

With a regular gang using the platform type of hoist it is possible to hoist about 100 cu.yd. per day of eight hours, or enough to cover 5500 sq.ft. of floor, including slabs with beams and girders incased. The hoisting charges for this work would be from $19 to $19.50, or about $0.0035 per square foot. With a self-tipping ½-cu.yd. bucket, an average day's work would be about 150 cu.yd. of concrete, or 8,000 sq.ft. of floor area, including casing of beams and girders. The cost of this bucket is about $25 per day, or a hoisting cost of $0.003, to which cost must be added a few more men as wheelers and spreaders, which would probably raise it to $0.0045.

Using the Gardner buckets, of which one was installed on the Hotel Commodore for use while fireproofing, as high as 13,000 sq.ft. of floor was laid per day for several days in succession, and as high as 70,000 sq.ft. was laid per week of six full days. In July, 1918, 253,680 sq.ft. of floor slabs, including casing of beams and girders, were placed, and in August, 265,421 sq.ft. were laid. This is believed to be a creditable record, considering the labor conditions, and the fact that the hoist was one-quarter of the way from one side of the H-shaped building, necessitating extra wheeling on the runways from the far corners of the building, this distance being over 300 feet.

On this work the bucket, including the rental of the motor hoist, electric current and pay of engineer, together with that of three extra men on wheeling, cost $31 per day. An average run was 12,000 sq.ft., or at the rate of $0.0026 per square foot. This represents a saving of about 25% in hoisting, over the platform type. The saving over the tipping bucket is about 42 per cent.

Two of the characteristics of this hoisting device are the speed with which it works and the large amount of material it carries. The towers in the Hotel Commodore extended 309 ft. above the sidewalk and 351 ft. from the sub-basement to the top of the pent-house. The round-trip time for the bucket averaged 2½ min. To supply the fireproofing gang, two continuous mixers at the bottom were dumping continuously into a hopper, which, in turn, fed the Gardner bucket.

While bricklaying was in progress the contractors used one hoist and one mixer to supply mortar to 500 bricklayers. In doing this, deliveries were made at five different floors at the same time with one hoist, an operation that could not be performed with the tipping bucket.

The contractor for the Hotels Pennsylvania and Commodore was the George A. Fuller Co., of New York. Thomas Smith was superintendent on the Hotel Pennsylvania and B. L. Norris was superintendent on the Hotel Commodore. The buckets were furnished on a rental basis by H. F. Gardner, of Newark, N. J.

Report of the Canadian Commission on Industrial Relations

The majority report of the Canadian Commission on Industrial Relations recommends: Legislation for a maximum work day of eight hours, with weekly rest of not less than twenty-four hours; a minimum wage, especially for women, girls, and unskilled labor; Government action to relieve unemployment through public works, to help the building of workers' homes, to restore fullest liberty of speech and press, and to establish a bureau for promoting industrial councils to improve the relations between employers and workers; immediate inquiry by experts into the system of proportional representation in parliamentary elections and into state insurance against unemployment, sickness, invalidity, and old age. Other general recommendations are: Collective bargaining; payment of a living wage; right of workers to organize; recognition of unions; steps toward establishment of joint plant and industrial councils; and extension to the poorest workers' children of opportunity to reach the highest educational institutions.

Topographical Surveying on Atacama Desert in Chile

Major Topography Obtained By Triangulation—Special Rod Designed For This Work—Climatic Conditions Give Difficulty

By B. L. G. Rees
Washington, D. C.

TOPOGRAPHICAL surveying on the desert and nitrate lands of Chili is attended with many difficulties, due to the nature of the country. On a recent survey of 150 square miles of the Atacama desert to determine the extent of the nitrate deposit, the magnitude of the project, the limited time allowed for the work, the small number of the engineers available, and the difficulty of making observations over the hot desert land, made it necessary to develop some modifications and several new applications of the usual methods employed for both the field and office work. Principal among these may be mentioned the method of taking the topography by triangulation over long distances by the use of a specially designed rod, computing the elevations and distances by means of the vertical and horizontal angles.

The property to be surveyed was on the Antofagasta pampa (desert nitrate lands) about 100 miles inland from the port of Antofagasta. It consisted of 80 pertinencias (claims), very irregularly covering about 100 square miles of rugged and rolling country. The problem was to locate sufficient detail for a topographical map on a scale of 1 in 20,000, showing 20-meter contours, locating the governing corners of each pertinencia, connecting the survey with existing railroad surveys, and showing the governing exterior topography. The total area covered by the survey was about 150 square miles.

Meteorological conditions are such in this territory that it is entirely rainless and totally devoid of vegetation. The tropical sun under cloudless skies produces an intense radiation, such that instrumental work is limited to short-distance sights most of the day. The wind blows nearly every day and is usually constant, but changes direction throughout the day. Due to violent boiling of the atmosphere above the desert surface, it was impossible to use a stadia rod for distances over 300 m., which was impracticable for so large a project and the limited time to finish the survey. The only solution was to have the instruments, for both the triangulation system and for taking major topography, high enough above the main pampa to avoid trouble due to this boiling atmospheric condition. This was accomplished by using triangulation stations located on the hills.

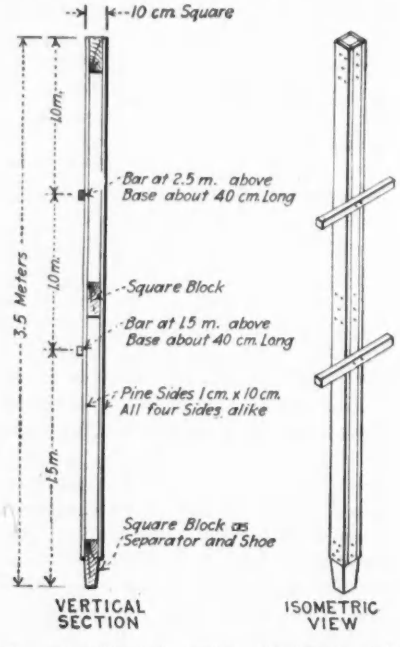
Triangulation System

More than 50 triangulation stations were used for the main triangulation system. The north and south length of the tract, which was roughly rectangular, was 30 km. (18.6 miles), and the width was 13.5 km. (8.3 miles). The elevation varied from 1745 m. (5725 ft.) to 2350 m. (7700 ft.). A base line of 1227.56 m. (4027 ft. was established east and west near the center of the property and was expanded by quadrilaterals to a developed base line of 5220.2 m., between two prominent peaks. Elevations above sea level were established by trigonometrical leveling from a railroad survey near the south end of the property.

Wood being unobtainable and rock abundant, the triangulation stations were made by piling rock around the flagpole marking the station. The top of the pole was set 1.5 m. above the ground (equal to the average height of the instrument) to establish a definite point for observation and to eliminate the correction for height of instrument. Precision was not attempted, but accuracy was required in the measurement of angles. With a transit reading to 30 seconds and a vertical circle to 1 minute, both horizontal and vertical angles were read once erect and once inverted, but were repeated if they did not check within the reading of the vernier. Magnetic bearings of all sights were noted to determine variation.

Topographical Field Work

After the triangulation was completed the major or exterior topography, which consisted of that which was not taken in the survey of each separate pertinencia, was started. On this work unusual features were developed to rush the field and office work, a special rod being used for the observations. The long-distance shots necessitated by placing the instrument above the boiling atmosphere of the desert made it impossible to read the ordinary stadia rod. A special rod was, therefore


10 cm Square
1.0m.
Bar at 2.5 m. above Base about 40 cm Long
1.0m.
Square Block
3.5 Meters
Bar at 1.5 m. above Base about 40 cm Long
Pine Sides 1 cm. x 10 cm. All four Sides alike
1.5m.
Square Block as Separator and Shoe
VERTICAL SECTION
ISOMETRIC VIEW

DETAILS OF SPECIAL TRIANGULATION ROD FOR TOPOGRAPHY

devised, which was 3.5 m. (11.5 ft.) long and with a cross-section 19 cm. (4 in.) square. It was made of thin pine and was hollow. The rod, which is shown, was painted with white enamel and was visible for a distance of 3 to 5 km. Major topography was taken by a party consisting of two observers, each having a native assistant, and a topographer accompanied by an assistant who carried the special rod, a signal flag and a pair of field glasses. The topographer decided the point to be located and noted a description of the topographical features governed by it while the rod held by the assistant was being located by the two observers.

The two best engineers in the party were selected as observers. Each of these had a transit, a shelter tent

to protect the instrument from the wind, a signal flag about 1 m. square, a wrist watch and a notebook. Accompanied by his assistant, each occupied a designated triangulation station. Stations were usually from 3 to 5 km. apart, plainly visible from each other and both controlling the section to be surveyed. These stations were usually occupied for the day, because they generally controlled all of the topography that could be surveyed in that time, and at least an hour was required for an observer to change stations. However, when it was necessary to change, this fact was indicated by flag signals from the topographer. Each observer set zero for angles on the other observer. During the day each observer made a topographical sketch of the hill on which his station was located.

Method of Taking and Recording Topography

When the topographer had taken up his position where the day's work was to start, his assistant set up the signal flag (1 m. square) to assist the observers in locating the starting point. When ready, the observers signalled, and the topographer's assistant placed the special rod on the point to be located and held his signal flag with the pole horizontal on the cross-bar of the special rod, 1.5 m. above the ground. The observers then set the horizontal cross-hair on this flagpole and split the rod with the vertical hair. These two settings finished the observations, and the observers signalled with their flags, which determined the time, to the minute, when the shot was taken. The observers recorded this time opposite the serial number of the shot in their notebooks, together with the horizontal and vertical angles. Shots were numbered serially in blocks of 10 and checked after each tenth shot by a signal from the topographer's assistant, thus avoiding any extensive error. The time record of each shot proved to be of great value. A special signal was given at exactly noon and at 3 p.m. by the topographer's watch, to correct watches.

A large square-ruled cross-section book was used by the topographer, who also carried a map, a Brunton pocket transit, which proved to be invaluable, and a wrist watch. After he had made notes describing the point, in the spaces opposite the serial number in his book, it was only necessary to note the time when the observer signalled. The complete topographer's notes, including later additions made in the office each evening in camp, are illustrated by the sample pages here reproduced. The notes were supplemented by topographical sketches when considered advisable.

Rapid, though accurate, observers were the factors determining the speed element of the work. The average day's work was 50 to 100 shots, covering a range of 10 to 15 km. Each point frequently governed a radius of ½ km. to 1 km. It seems to the writer that this method of surveying, with certain modifications, is readily applicable to many sections of the United States where speed and accuracy of stadia work are sufficient.

Interior Topography

For the purpose of sampling this property to determine the nitrate content, each pertinencia was divided into squares 100 m. on a side, and a sample hole 9 in. in diameter was drilled at all the corners. These sample holes were located by stadia survey parties, since greater accuracy was not required. By the use of diagonals to the squares, it was possible to locate 20 sample holes from one set-up. The chief of the party made a topographical sketch at each pertinencia as the sample holes were located, and kept a record of the stadia data used in locating the holes. This work was started at a property corner marker, which was located from the triangulation stations by the major topography party. These records formed a set of topographical notes complete for each pertinencia and was called the interior or stadia topography.

Computation of the triangulation system was the first work to be done in the office. The triangles were balanced and corrections were made for curvature and refraction to establish the elevations by trigonometrical leveling. Then the coördinates and azimuths were computed. For curvature and refraction corrections in meters, the formula was reduced to $\log C = 2 \log K + 2.8292647 - 10$, where C is the correction and K is the distance. A chart of this formula was used for topographical shots of over 4000 m. Elevations were kept to the nearest meter on topography.

In plotting the major topography two men worked together. One, the computor, had the topographer's field book which contained all angles as well as a description of each point. While the other was plotting, he computed, with a 20-in. slide-rule, the distance from the two triangulation stations to the located point, the difference in elevation for each, and the final elevation for the point. The second man did the plotting and by scale checked the computor. On a plot of 1 : 20,000, a distance of 20 m. in the field is represented by 1 mm. (1/25 in.) on the map, which makes slide-rule computations closer than plottings.

Reading vertical angles simultaneously from two stations to the same point was a very great advantage. In case one angle was missed or otherwise not available, there was always one vertical angle to determine the

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JULY 15 1917		INSTS. ΔB (JONES) & ΔC (SMITH) TOPO BY REES	INST. AT ΔB		INST. AT ΔC		B TO C DIST.	2016M FROM	1712 DIFF. ELEV. FROM	1761		CHECKED
NO.	TIME	DISCRIPTION	HOR. A	VER. A	HOR. A	VER. A	ΔB	ΔC	ΔB	ΔC	ELEVATION	
47	2:14	(+1) LIND K 37-F-80Z-NW-SE 12° C.P. TOP KNOLL SL 22° ALL WAYS +52°	47-3°-10'		-78°-14'	-3°-40'	2130	2615	-118	-167	1594	✓
48	2:17	C.P. PAMPA SL. N+10° S-5° E&W 0°	+49°-41'	-8°-18'	-55°-16'	-10°-39'	1715	1590	-250	-299	1462	✓
49	2:19	C.P. R.S. (10M) NO BANKS NW-SE 18° SL. N15° S-10°	+61°-08'	-9°-12'	-52°-16'	-11°-44'	1925	1740	-312	-360	1400	✓

SAMPLE OF TOPOGRAPHER'S NOTBOOK

Column 1 shows the serial number of the observation; column 2, time the shot was taken; column 3, complete description of the point as made on the ground; columns 4 and 5, field notes of one observer as copied from original in camp; columns 6 and 7, field notes of the second observer as copied from original in camp; column 8, at top is distance between stations, below is distance from first station to located point as scaled and computed by slide-rule; column 9, same as column 8 for the other station; column 10, at top is elevation of station, below is differerence in elevation between station and located point; column 11, same as column 10, but for the other station; column 12, final established elevation of the point as checked from both stations.

elevation. Otherwise, the elevation would be indeterminate and the topographic value of the point lost. Also, in case one of the horizontal angles was missing, the two vertical angles made it possible to determine the position of the point close enough for plotting. The topographical details were worked out from the plotted governing points, together with the description of these points noted in the topographer's field book, and from the stadia-survey notes furnished by the parties locating the test holes.

Huntington Adams was in charge of this project, and under him the writer had charge of all surveys, maps and calculations, and later acted as his general assistant.

Moving Three Large Steel Tanks 150 Miles by Water

Due to Material and Labor Scarcity, It Was Cheaper To Move Storage Tanks Intact Than To Dismantle or Build Anew

By A. J. Taylor
The Taylor Engineering Co., Limited, Vancouver, B. C.

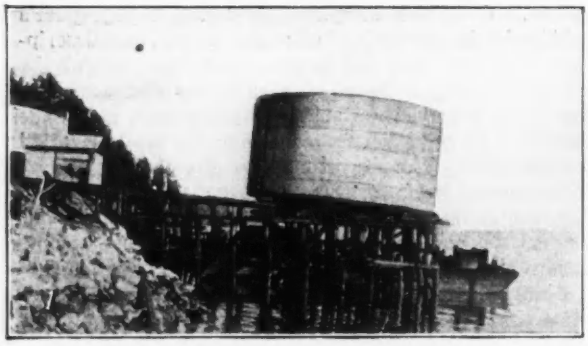
THREE large steel tanks, each 60 ft. in diameter and 30 ft. high, were moved during the war 150 miles by water because this action was found to be the cheapest method of supplying necessary storage. The Powell River Co., operating a very large paper mill at Powell River, B. C., resorted to this alternative early in 1918 to provide immediate additional fuel-oil storage capacity of 45,000 bbl., to accommodate the last cargo of fuel oil that they expected to be able to obtain from the California fields during the war.

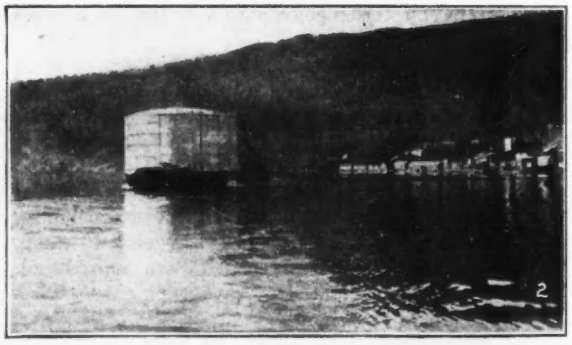
Upon investigation, it was found that not only was the price of steel tank plate almost prohibitive, but it was impossible to obtain the necessary plates within the desired time. Concrete storage tanks were considered, and it was found that a tank with a capacity of 45,000 bbl. would have cost about $60,000, and would have been more or less of an experiment when completed.

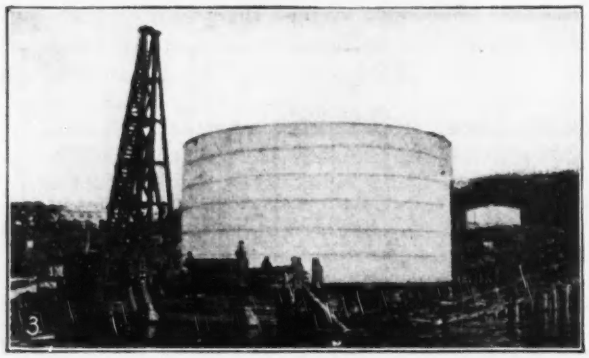
The situation appeared almost hopeless until it was discovered that the Associated Portland Cement Co. at Bamberton, B. C., 150 miles south, on the Strait of Georgia, had three 15,000-bbl. steel storage tanks that they were not using and were willing to sell. These were purchased on the foundations, as they stood at Bamberton, for approximately $24,000.

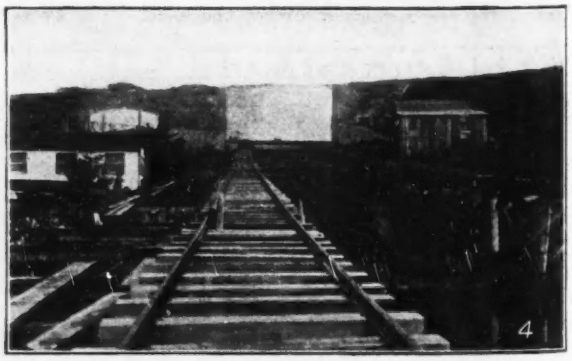
The question of transferring these tanks from Bamberton to Powell River was next tackled, and it was at first thought that the only way of doing this would be the usual method of cutting the tanks down and re-erecting them. But on account of the large program of the Imperial Munitions Board for the construction of wooden and steel vessels in the neighborhood of Vancouver, there were only three or four boiler makers available, and only one of these had any experience in tank work. In other words, it was practically impossible to get an adequate supply of labor to cut down and reërect these tanks.

It was then determined to move each of the three tanks in one piece, after the calculations had been made to determine its stability when mounted on a 30 x 80-ft. scow. Two lines of piles were driven at Bamberton opposite the point at which the tanks were located. The tanks were lifted from their foundations by means of jacks, and set out over the water at a sufficient distance above the water so that the scow could be run in between the lines of piles at low tide, and, after the tide came up, each tank would settle on a scow and the scow and tank be pulled free of the trestles.









1. SCOW MOVING INTO POSITION UNDER TANK AT BAMBERTON; 2. FIRST TANK LOADED AND LEAVING BAMBERTON; 3. BLOCKING UP FIRST TANK AT POWELL RIVER, PREPARATORY TO MOVING SCOW; 4. PULLING TANK UP INCLINE TO FINAL LOCATION AT POWELL RIVER

To brace the tanks internally so as to eliminate as far as possible the strain that they would be subjected to in their journey a 2-in. hole was drilled in the center of the bottom of each tank, and in this hole a shackle was mounted from which was set up a series of turnbuckle guys from the top edge of the tank to the shackle. The structure of each tank was depended upon to prevent the sides being pulled in by the strain on the turnbuckles.

Each tank, after it was floated onto a scow, was towed to Powell River, at which point four lines of piles were driven, and a space was left between each pair of lines that would admit the scow. From the landing platform double tracks were extended up approximately 800 ft. to the final location for the tanks, these tracks being spaced so as to accommodate standard-gage trucks.

The scow was floated between the trestles, which were at such height that at high tide there was ample space between the bottom of the tank as it projected on each side of the scow to enable the railway trucks to be run underneath. As the tide lowered, it left each tank supported on the trucks. The tank was then hauled up the inclined runway to the foundation that had been prepared, by means of a 7 x 10-in. double-drum engine that was installed on the piledriver that had been used to drive the piles for the trestles.

The three tanks were unloaded and the job was completed within 30 days, at a total cost of $14,000, which was nearly $5,000 lower than the lowest tender received from local iron works for cutting down and reërecting the tanks. The total cost to the Powell River Co. of the three tanks complete was $38,650. The tanks were landed on their final foundations and tested were found to be absolutely free of leaks, evidence that they were not seriously strained in the moving operation.

All of the moving operations were carried out by the Taylor Engineering Co., Ltd., of Vancouver, B. C.

Haul Gravel With Caterpillar Tractor in Minnesota

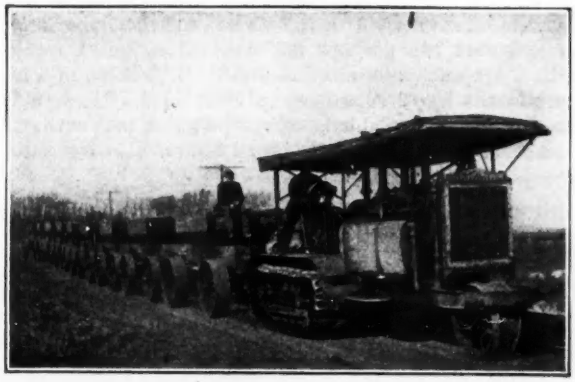
Renville County Uses a 120-Horsepower Machine With a Train of Nine Wagons, the Load Being 30 Cubic Yards — Itemized Costs Given

HAULING gravel in trains drawn by a 120-hp. caterpillar tractor has been resorted to in Renville County, Minnesota, with what are considered excellent results. Cost per yard-mile ranging from 10 to 32c., according to length of haul, were given by F. M. Shepherd, county highway engineer, in a report dated Nov. 1, 1918. The trains consisted of the tractor and nine wagons, as shown in the illustration.

During 1916 the county used a 75-hp. caterpillar for hauling gravel with such success that the commissioners decided to purchase a larger machine for the 1917 work. Accordingly, a 120-hp. Holt machine was purchased, which could haul a longer wagon train, and the 75-hp. machine was assigned to grading work with a 12-ft. grader. The average costs of hauling gravel over a period of two seasons are given in the accompanying table. These costs include interest, depreciation, fuel, oil, salary of operator and helper, repairs, etc.

With a train of nine wagons the total capacity was 30 cu.yd. The maximum mileage was produced at hauls of 3, 4, 6 and 8 miles, when 12 miles per day with load could be realized. As will be seen from the table, the lowest loading cost per mile was on the three-mile haul. The lowest combined costs of loading and hauling, considering the length of haul, were on hauls of six and eight miles. At the five- and seven-mile hauls, the loss in trips per day, plus higher loading costs per yard, operated to increase the total cost proportionally, above that for the three- and four-mile hauls.

With the 120-hp. caterpillar the rate of travel, loaded, was 2.18 miles per hour at the normal engine speed of 550 r.p.m., and three miles per hour running light.



TRACTOR RETURNING WITH NINE EMPTY CARS

The track width of the caterpillar is 24 in. on each side, or 48 in. in all, and the length of contact with the ground is about 80 inches.

Printing Telegraph Valuable During War

During the five-year period 1912-1917 the printing telegraph came into extended use by telegraph companies, press associations, and railroads. It consists essentially of a sending instrument, equipped with a keyboard similar to that of a typewriter, electrically connected with a receiving instrument in such a manner that the latter automatically reproduces what is typewritten on the sending instrument. Without the printing telegraph it would have been difficult or impossible to handle the increased business during the war.

PERFORMANCE OF 120-HORSEPOWER CATERPILLAR TRACTOR IN HAULING GRAVEL FOR ROAD WORK IN RENVILLE COUNTY MINNESOTA

Haul, Miles	Average Performance: Number of Trips per Day	Load per Trip Cu.Yd.	Amount per Day Cu.Yd.	Yard-Miles per Day	Average Costs: Hauling: Cost per Day	Hauling: Cost per Cubic Yard Mile	Loading: Cost per Day	Loading: Cost per Cubic Yard	Cost of Loading and Hauling per Cubic Yard for Various Hauls
½	8	30	240	120	$38.00	$0.317	$36.00	$0.15	$0.31
1	6	30	180	180	38.00	.211	30.00	.17	.38
2	5	30	150	300	38.00	.127	24.00	.16	.41
3	4	30	120	360	38.00	.105	18.00	.15	.47
4	3	30	90	360	38.00	.105	18.00	.20	.62
5	2	30	60	300	38.00	.127	12.00	.20	.83
6	2	30	60	360	38.00	.105	12.00	.20	.83
7	1½	30	45	315	38.00	.121	12.00	.267	1.11
8	1½	30	45	360	38.00	.105	12.00	.267	1.11

Sewage and Dissolved Oxygen in New York Harbor

No Putrefaction in Main Channels Likely During Cold Months of Year—Increasing Reduction of Oxygen in Warm Months Points to Growing Need for Some Degree of Treatment

By Kenneth Allen
Sanitary Engineer, Board of Estimate and Apportionment, New York City

In 1909 the Metropolitan Sewerage Commission of New York took up the systematic study of the dissolved oxygen contents of New York harbor, as being the best general index of the degree of pollution existing at different points and of its change from year to year. Since the close of its observations in 1913 this work has been carried on by the Board of Estimate and Apportionment, of which Nelson P. Lewis is chief engineer, with results which confirm the earlier conclusions as to the steady and, in some locations, the rapid approach to a condition where nuisances from odor may be expected.

As is well known, the depletion of dissolved oxygen is due to bacterial activity brought about by the presence of organic wastes, such as sewage, and it has been recognized for a long time that the inhibiting effect of cold on such activity would result in an increased percentage of saturation in the water, but the importance of this fact has perhaps not received sufficient recognition. It was emphasized by Dr. D. D. Jackson in a report to the board submitted in May, 1914. Its significance is shown in Table I. It will be noted that with one exception (Willis Ave.) the April figures all show saturation of over 70 per cent.

TABLE I. PER CENT. SATURATION OF DISSOLVED OXYGEN IN THE WATERS OF NEW YORK HARBOR

	April			Average for June,	July,	Aug. and Sept.
	1915	1916	1917	1915	1916	1917
Narrows			80.5	79	66	63
Upper Bay, Robbins Reef			84.5	72	64	50
Hudson River, Pier A	88		82.5	42	47	46
155th St	83		81.0	39	40	37
Spuyten Duyvil	93		81.5	46	51	
Harlem River, Morris Heights	82		73.5	25	25	25
Willis Ave	65		78.5	22	15	13
East River, Pier 10	88.2		71.3	35	23	27
23rd St	79		79.8	34	31	35

The practical deduction to be drawn from these observations is that there need be no apprehension of a nuisance due to putrefactive odors from the main channels of the harbor in the colder months of the year, and that therefore it will probably not ever be necessary to provide costly methods of sewage treatment to maintain satisfactory conditions in this respect during the winter months, provided that any large volumes of putrescible effluents are discharged only at suitably located outlets and with provision for a rapid mixing with the harbor waters. Consequently, if it should ever be desirable to establish an activated-sludge plant at a given location there would be no necessity for operating it, except as a sedimentation plant (unless for the recovery of fertilizer) during perhaps half the year, thereby avoiding a considerable expense to the city.

If a residuum of dissolved oxygen were assured at every point in the harbor, no odors would be evolved by the water, but as channel saturations fall below 30 or 40% the danger of local nuisances near outlets and in the slips increases, especially where sludge deposits exist, belching forth gas in hot weather. So it is of great interest to follow the progressive *maximum* depletion of oxygen in warm weather at certain points, notably in the East and Harlem Rivers. This has been quite marked, as shown by Table II and Fig. 1.

TABLE II. MINIMUM PERCENTAGE SATURATION OF DISSOLVED OXYGEN IN THE WATERS OF NEW YORK HARBOR

	1909	1911	1912	1913	1914	1915	1916	1917	1918*
Narrows (78% in 1906)	67	64	61	52	45	54	48	46	64
Upper Bay, Robbins Reef	64	64	53	38	70	58	51	42	53
Hudson River, Pier A	55	51	43	20	31	25	29	25	45
155th St					36	22	25	20	39
Spuyten Duyvil or Mt. St. Vincent		74		60	44	35	28		36
Harlem River, Morris Hts.	46	40	33	11	6	8	0	1	4
Willis Ave.		29	21	19	0	6	1	0	2
East River, Pier 10	69	51	25	13	19	22	17	19	18
23rd St	55	55		15	28	19	8	10	15
42nd St	57	51	29	53	26	24	4	10	
(95% in 1906)									

* The lower of a single series of top and bottom samples taken July 16 to 18. Lower results would undoubtedly have been obtained later, but work was prevented by war conditions.

The observations indicate that since 1909 the general reduction in the oxygen content of the harbor water during the warm months has been as follows:

	In Percentages		
	From	To	Decrease
Narrows	83	63	24
Upper Bay	67	50	25
Hudson River	72	42	42
Harlem River	55	22	60
Upper East River	86	47	46
Lower East River	65	29	55

The samples from which the results shown in Table II were deduced were, in general, taken from near the surface in the main channels. To obtain information as to the variation in different parts of the stream, samples were analyzed from various cross-sections with the results shown in Fig. 2. Similar tests were made by the Metropolitan Sewerage Commission and described in Chap. VI, Sec. III, of its final report.

The conditions are in a state of continual change, but these tests appear to indicate that:

1. At the Narrows there is no great difference from side to side but that, due to the underrun of clean ocean water the saturations are higher near the bottom.

2. This also holds true as to the Hudson River, except that here the oxygen is somewhat less near each shore on account of the admission of sewage. But above Dyckman St. the effect of the sewage pollution is less, results are more uniform and the upper layers are often better supplied with oxygen than the lower.

3. In the East River there is a more thorough mixing, due to the currents; but here, too, the water near the bottom contains more oxygen, as the fresh sewage tends to rise on its discharge. Above Hell Gate the influence of the clean Sound water is more marked, and relatively high oxygen figures predominate near the bottom.

No more convincing proof of the effect of the increasing load of polluting matter discharged into the harbor without treatment is necessary than the above-mentioned table and diagrams. Already the Harlem River has become so foul that between the Willis Ave. and 155th St. bridges total depletion for short periods probably occur every year, and if this condition should be prolonged intolerable odors would result.

The proper solution of the whole problem of sewage-

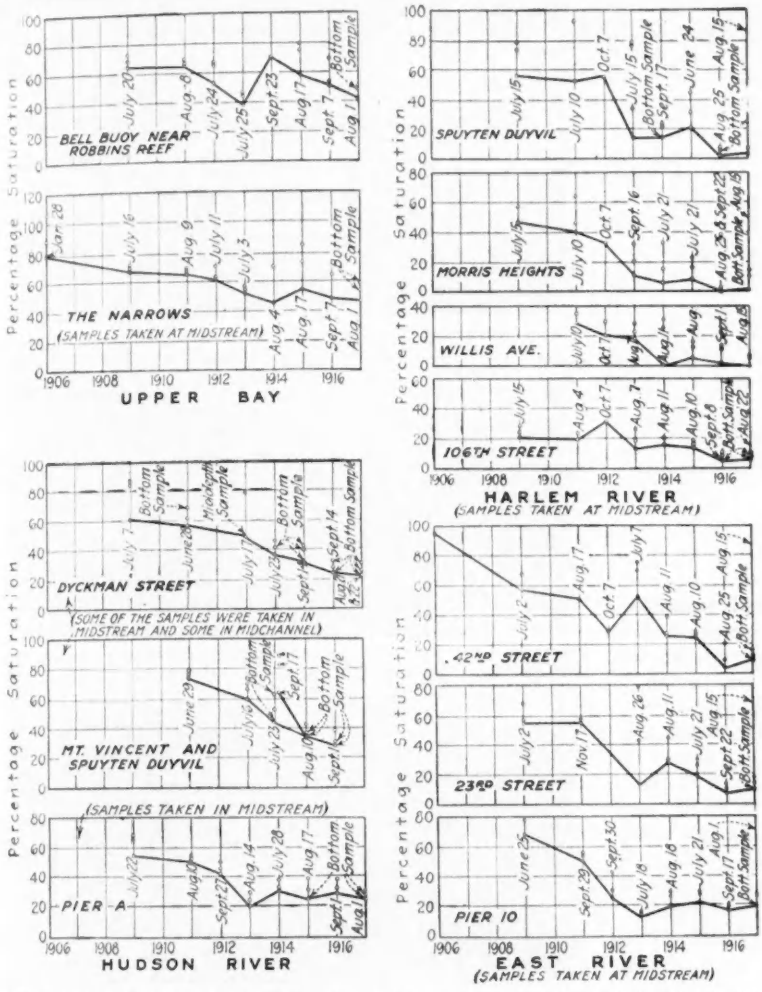
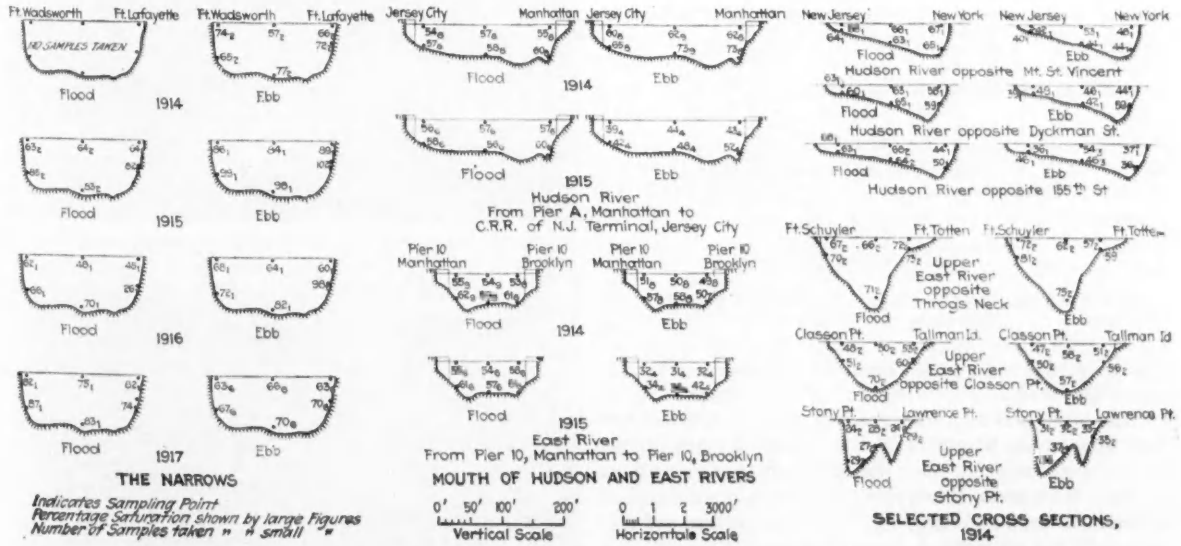


FIG. 1. OBSERVED PERCENTAGE OF DISSOLVED OXYGEN IN WATERS OF NEW YORK HARBOR, 1906-16

All samples were taken near the surface, except where noted. The diagrams are from the 1917 report of the Board of Estimate and Apportionment, New York City.

disposal confronting New York City really depends upon the available dissolved oxygen in the harbor. Generally speaking, the excess above, say, 40% saturation can be utilized in purifying the filth poured into it. But the computation of this available supply is very difficult. The writer has attempted it several times, but with no confidence in the results. This is because so many and such variable factors have to be considered: The tidal flow, the fresh water discharge, the salinity, the temperature, the depletion of oxygen due to decomposing sludge deposits, reaëration from the atmosphere, etc., all of which are constantly changing, and the growth of the tributary population and the volume and character of industrial wastes for a long term of years.

If the visible solids are removed by screens or tanks, that measure, with the interception of sewage to certain strategically located points, will be the first and most obvious step in advance. This much can in many cases be done without further information, because topographical conditions and important centers of population are not subject to great change, so that lines of collection are pretty well prescribed; and this will alleviate certain local objectionable conditions. All development should be along predetermined general lines, but where any question as to future condition exists, plans should have sufficient elasticity to permit the adoption of more refined methods of treatment later if such action is found desirable.



Indicates Sampling Point
Percentage Saturation shown by large Figures
Number of Samples taken " " small "

FIG. 2. AVERAGE PERCENTAGES OF DISSOLVED OXYGEN AT VARIOUS CROSS-SECTIONS, NEW YORK HARBOR

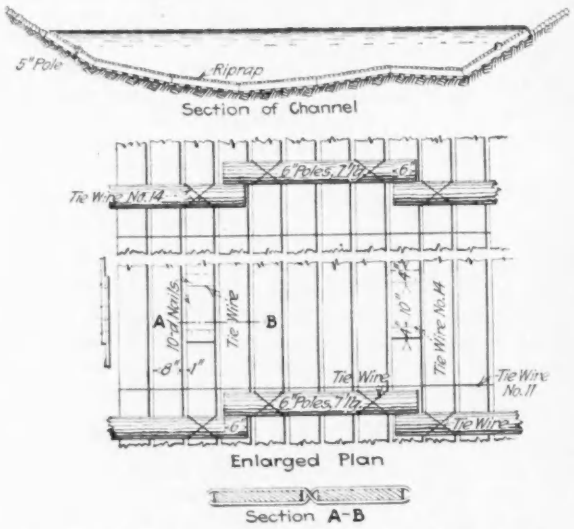
Sinking a Long Board Mattress in a Narrow Channel

Built Up in One Section 300 Feet Long, Suspended From Bank by Wires and Sunk by Force of Current

TO PREVENT scour through the contracted section of a drainage channel in the Little River Drainage District in Missouri, the expedient was adopted of sinking a long board mattress as a unit. The entire structure, 300 ft. long and 40 ft. wide, was built up suspended on wires attached to deadmen at the top of the channel slope and dropped into place while the water was going through the channel. Further protection was had by covering the wood mat with riprap.

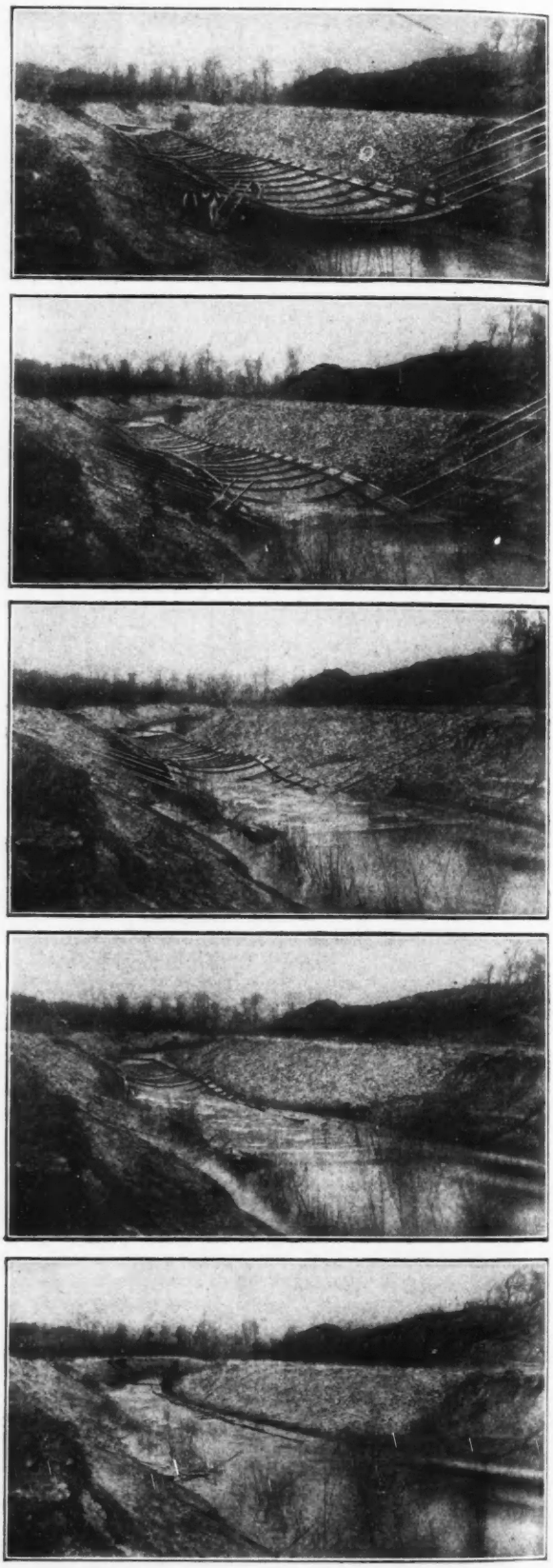
At the east end of the drainage district's headwater diversion system near Cape Girardeau, Mo., there is a contraction in the channel to control the outfall from the basin above. After the channel was excavated and before water was let into it, a considerable reach of the side slopes was protected from erosion by stone riprap, but at that time it did not appear necessary to protect the bottom of the channel. Later developments showed that such protection was necessary for a stretch at the end of the channel, mainly on account of the high velocity, which reaches approximately 7 ft. per second at low stage. This velocity was the main reason for the method adopted, that of lowering the mattress into place.

The top width of the channel is 90 ft., and the width at the water line is approximately 35 ft. As shown in the drawing, the mattress was built up on No. 4 steel



SECTION THROUGH CHANNEL AND PART PLAN OF BOARD MATTRESS

wire suspended across the channel from deadmen at the top of the bank. These boards, in 12-, 14- and 16-ft. lengths, were spliced and lapped to form lengths about 50 ft. long in the direction of the thread of the channel, and these strips were then wired transversely to form the 40-ft.-wide mat. When five or six boards were nailed together in the 50-ft. lengths, they were pushed off the bank onto the suspended wires, and workmen got out on the boards and laced them together to form the mattress shown. As soon as the boards were wired or



PROGRESS IN SINKING 300-FOOT BOARD MATTRESS IN DRAINAGE CHANNEL

laced into the mat a ¾-in. cable was securely fastened to the upstream end and to a deadman on top of each bank, to hold the mat in place in the channel when it was launched. Cross-poles were then attached to the plank for the purpose of keeping the riprap in place after the mat was sunk, and a line of longitudinal poles was placed at each side to hold the side slope riprap.

When the whole structure was completed, the upstream end of the mat was weighted with a sufficient number of stones to pull it down into the water, and the rapid current then rushing over the mattress pushed it down into the water for the whole length. As soon as the water commenced to run up the mat the suspension wires let down from the weight of water. While but one of them broke, all were stretched considerably and were easily broken by a sharp tap with a hammer. Once the mattress was submerged the final weighting with riprap was accomplished by dumping from a suspension bridge across the channel.

The work was done under the direction of L. L. Hidinger, chief engineer of the Board of Engineers of the Little River Drainage District, and under the immediate supervision of H. W. English, resident engineer.

Wider Powers for Wisconsin State Board of Health

Controls Design and Operation of Water and Sewer Systems and Disposal Plants, With Power to Order Changes

CONTROL of the construction and operation of water-supply and sewerage systems and sewage and refuse disposal plants in Wisconsin is conferred upon the State Board of Health by a law passed recently by the legistature and signed by the Governor.

The board is given control of the surface and subsurface waters of the state so far as their sanitary and physical condition affects public health or comfort. This includes making rules and ordering changes to prevent pollution. It is to investigate all sources of water and ice supply, all water and sewerage systems and sewage or refuse disposal plants, keeping records of all such investigations. Furthermore, it is given power to compel the operation of these systems and plants in such a manner as to protect public health and comfort, or to order their alteration, extension or replacement.

On request the board will advise any owner (local authority, firm or individual) as to sources of water-supply and methods of providing for their purity and also as to methods of sewage and refuse disposal. For this work it may conduct investigations and experiments and hold public meetings, but no owner is required to bear the expense of such consultation, advice or experiment. It is provided specifically that the advice must only outline the best course to be pursued and that the board shall not be required to prepare plans. All prospective owners must file complete plans of projected water-supply and sewerage systems and disposal plants, and the board may require the filing of plans of old works as well.

As to efficient operation, the law provides that when the board finds any such system or plant is a menace to health or comfort or creates a nuisance it may require certain operating results to be secured within a certain time. If this is not done, the board may require changes to be made that will permit of the desired results being obtained.

If an owner objects to an order by the board the dispute may be submitted to three referee engineers, two appointed by the owner and board respectively and the third by these two. Their decision must be rendered within 30 days, unless the time is extended by agreement. The owner is to pay 66% of the fees and expenses of these engineers, the balance being paid by the State Board of Health. An owner may also bring suit to vacate any order of the board. If an owner fails to comply with an order within the time specified he will be held as creating a nuisance which may be enjoined and he is liable to a fine of $10 to $5000 per day.

Lake-Water Diversion and Sewage Treatment at Chicago

Sanitary District Plans Compensating Works To Hold Lake Levels—Sewage Treatment To Supplement Dilution

THE question of the diversion of water from Lake Michigan for the Chicago Drainage Canal has been revived recently by a letter from Col. W. V. Judson, Corps of Engineers, U. S. A., to the Sanitary District of Chicago, intimating that unless steps are now taken to begin the purification of sewage there will be necessary a continual increase of the draft of water from the lake. He suggested also that if the district should be permitted to withdraw—either temporarily or permanently—more than the 4167 sec.-ft. now authorized by the War Department, then the district should be required to advance to the United States Government sufficient funds for works for regulating the levels of Lakes Michigan, Huron, Erie and Ontario.

In its reply, the district referred to its ordinance passed in January, 1918, offering to compromise the litigation over water diversion by paying to the United States Government the money necessary to build compensating works in the St. Clair and Niagara Rivers, as recommended by a board of engineers in 1914. In return, it was expected that the Government would fix the maximum withdrawal of water at Chicago at 12,000 sec.-ft. The cost was estimated by the board at $475,000, but in view of increased prices due to war conditions the district appropriated $600,000 and now stands ready to provide the money.

After a bill for this purpose had been introduced in Congress, it was referred to the Chief of Engineers of the United States Army, who stated—in February, 1918—that it could not be approved, principally because Canada objected on the ground of alleged lowering of water level at Montreal. The Sanitary District then took up this objection with the Montreal harbor board and others, and a plan was suggested for controlling the outlet of Lake Ontario by means of a dam in the upper St. Lawrence. In this way water could be stored for nine months and delivered during September—November in amount considerably larger than the normal flow of the river. This would more than compensate for the alleged lowering of level due to the Chicago diversion. The works as planned are feasible and will accomplish their purpose, according to a report made to the Sanitary District by Francis C. Shenehon, consulting engineer.

On the question of sewage treatment, supplementary

to dilution, the district points out that it has provided for the treatment of sewage in excess of the amount that could be diluted properly by the maximum flow in the rock section of the main channel, as well as for the treatment of trade wastes and the treatment of sewage in various localities where it is impracticable to deliver the requisite amount of dilution water. Some of these works are built or under construction, and land has been secured for others. In addition, for several years the Sanitary District of Chicago has carried on extensive experiments in the treatment of sewage and of trade wastes.

With reference to the hydro-electric plant at Lockport, the end of the canal, it is stated that during the 12 years of operation no additional water has been withdrawn from Lake Michigan for power purposes, this plant simply utilizing the power incidental to the operation of the Drainage Canal.

War Prices Subject of Bulletin

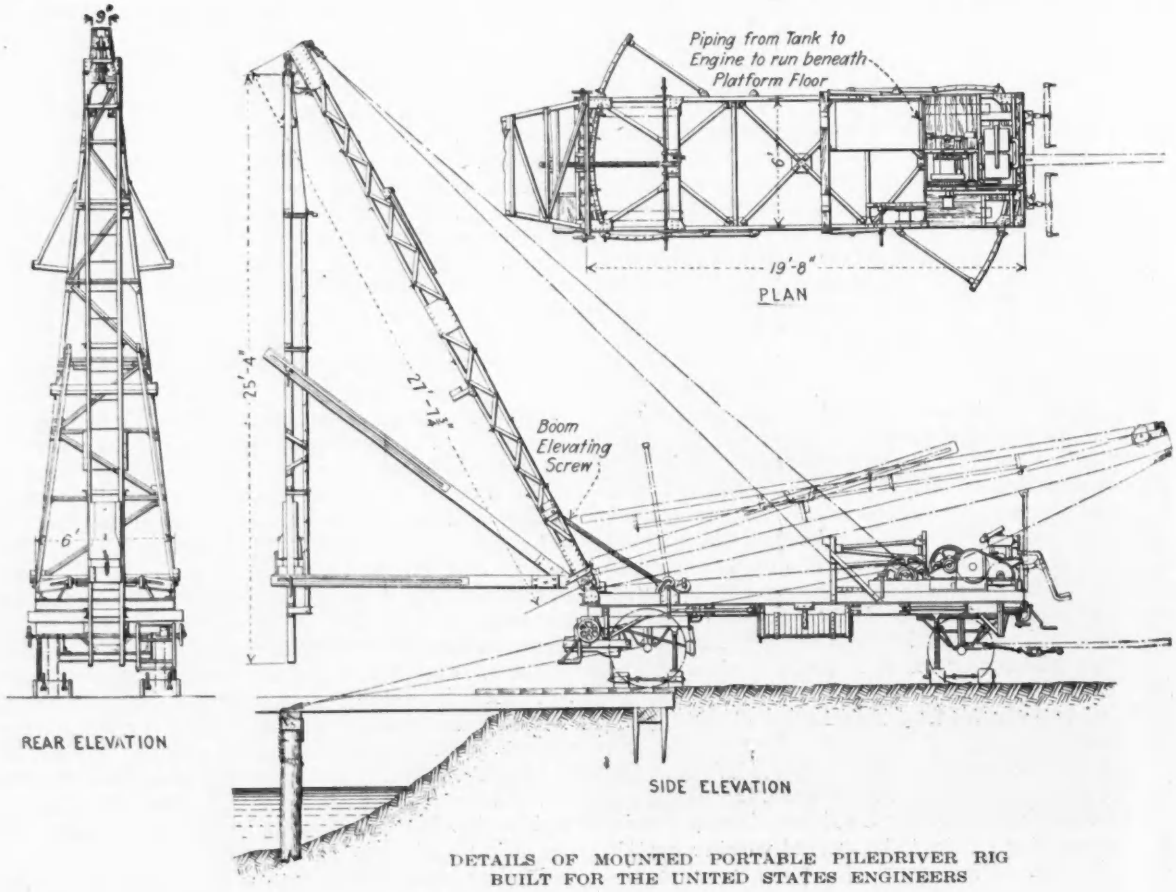
Prices of all commodities during the war were subject to considerable fluctuation and a gradual increasing rise toward the end. The United States War Industries Board was greatly concerned with these matters and has now for purposes of reference prepared bulletins on all of the various commodities subject to its direct or indirect control. Fifty-seven such bulletins will be issued, covering the general headings: Foods, clothing, metals, fuels, building materials and chemicals. The bulletin on cement contains a price chart from 1913 to 1918.

Mounted Piledriver Rig Developed by United States Army

Complete Outfit Is Readily Transported on Its Own Wheels and Can Be Used as Derrick, Shovel or Drill Rig

PILEDRIVERS mounted on trucks which could be readily pulled by motor trucks or horses were an obvious necessity for the engineer troops during the war. On this account the Corps of Engineers designed and developed a combination portable mounted piledriver to be used as a part of the engineer pontoon park for the engineer troops. The machine is mounted on a four-wheel truck and has the gross weight of 8200 lb. The main feature is the piledriving equipment, which permits of the driving of piles with a 950-lb. hammer in 25-ft. leads, but by slight rearrangement the rig can also be used for a drill with which to dig holes for telegraph posts, for a derrick, or for a steam shovel. The machine was designed by Capt. Alexander M. Bellony, Engineers, U. S. A., while he was in the General Engineer Depot as designing and purchasing officer of machines of special design. The first machine was built by the Clyde Iron Works, Duluth, Minn., and tested under actual working conditions on the St. Marys River at Duluth and on the Potomac River at Camp A. A. Humphreys, Virginia. There have been built, in all, 32 of the machines for the Army, 21 by the Flour City Ornamental Iron Works, Minneapolis, Minn., and 12 by the Clyde Iron Works, Duluth, Minn.

The machine consists of a four-wheel truck carrying

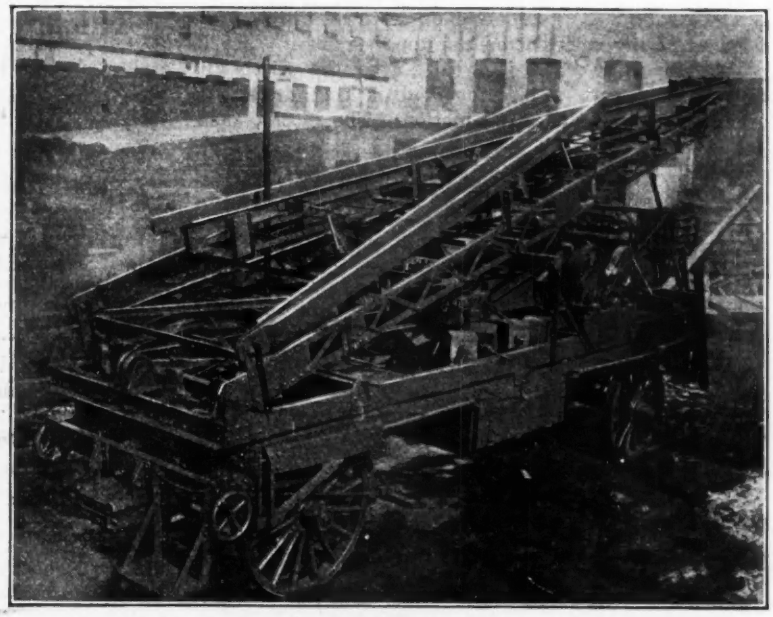


DETAILS OF MOUNTED PORTABLE PILEDRIVER RIG BUILT FOR THE UNITED STATES ENGINEERS

a main stationary frame and a superposed frame movable in the horizontal plane, which upper frame, in turn, carries at its forward end the A-frame boom and hanging leads and at the rear the engine and hoist. The leads and boom are folded down when the machine is being transported, the center of the folded portion resting on a timber cushion, which is supported and fixed on the upper frame. For this purpose the front end of the boom is provided with two legs bolted to the upper frame, which swing down to act as supports and also carry a seat for the operating crew.

The A-frame boom at its bottom end is pivoted to the longitudinal sides of the upper frame. The upper end is provided with two sheaves, one for the hammer and one for the pile line. The leads are 25 ft. long and have a 17-in. spread. The extreme height from the bottom of the wheel to the top of the leads is 32 ft., taking a pile about 30 ft. in height above the wheel base. If the penetration point is below this base, the length of the pile can, of course, be increased. The leads are connected to the boom by means of a locking hanging device assuring a suitable connection arrangement. Near the upper end of the leads, buffer blocks are provided to prevent the overpull of the hammer.

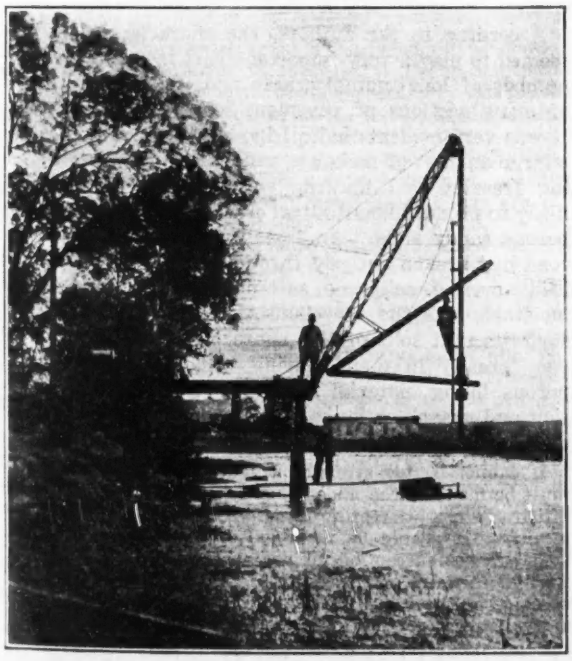
The leads are stiffened by sway braces, and the inner ends of both the lower and diagonal sway braces are pivoted near the foot of the boom. The other ends of the braces are provided with long, suitable slots, permitting the sliding of the leads in any desired position. To the leads are fixed the sway-brace supports and plates arranged with handle knots for fastening up braces to the leads, thereby stabling the leads under the operation of driving piles. In addition to this, the stabling of the leads is assisted by a lead cable-stiffening device which consists of two hand winches, one bolted to each side of the upper frame, and cables reaching from the winch to the leads. The cables travel through spools placed on the ends of the extension track.



ARMY PILEDRIVER READY FOR TRANSPORTATION IN THE FIELD

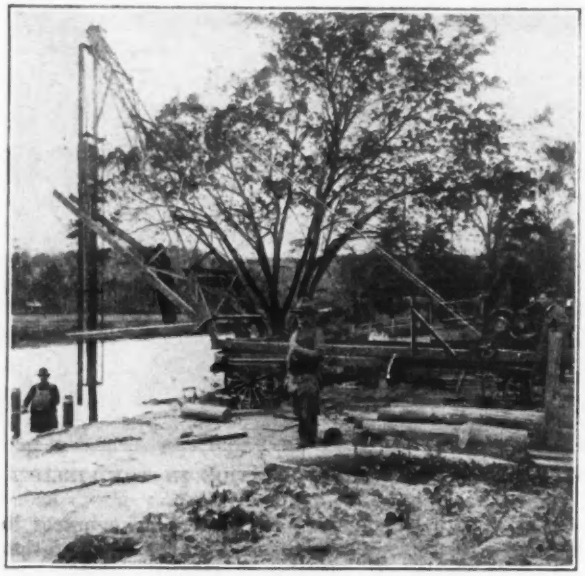
The front and rear ends of the lower frame have a circular track, extending beyond the sides. When the machine is under transportation the extended parts of the track fall flat to the sides of the lower frame. Each end of the upper frame is provided with five rollers and also with a pinion on the front end traveling on a rack located on the lower frame. The center of the frame is provided with a pivot pin constituting the rotatable axis. By the operation of the pinion on the front end, the upper frame can be rotated in any desired position, and by adjusting the boom with the boom cable winch the leads can be placed over any point of the chord, so that a straight line of piles can be driven in a length of 25 ft. with an extreme reach of the leads of 16 ft. This operation permits the driving of piles from one position without any movement of the machine other than the turning of the upper frame and the adjusting of leads and boom, which can be accomplished within a comparatively short time.

The hammer provided is a drop hammer weighing about 950 lb., although power hammers could be used. When the outfit is under transportation the hammer is placed, as shown in the view of the demounted machine, in a suitable hammer housing pivoted on the rear end of the lower frame, turned up into a horizontal position, and thereby the space between the rear wheels to the height of the axle is cleared. The engine furnishing the power for the operation of the rig is a 30-hp., 600-r.p.m. gas engine, located on the front end of the upper frame. To the engine is connected the hoist which operates the drop hammer, which can be utilized for any desired attachment with which the machine may be used.



SHOWING HOW THE MOUNTED PILEDRIVER CAN BE USED IN DRIVING PILES IN WATER

The machine is transported on its own wheels with the boom lying back flat on the upper frame. When it reaches the place where it is to be used, the wheels are first blocked with a blocking and jacking device, in order to prevent undesired motion. The blocks, fast-



DRIVING PILES WITH ARMY ENGINEERS' NEW PORTABLE PILEDRIVER

ened by screw shafts, provided on one end with a ratchet handle, fit the outer surface of the wheels. A jackscrew is housed in the blocks and takes part of the strain off the axle. A clamping device for stationing the two frames under operation and transportation will prevent the moving of the upper frame, and assure stability under any condition. The truck being fixed, the boom is then raised with a special screw device. This mechanism connects the boom and frame with an endless screw shaft, and can be operated by hand or by power. After the boom has been raised and passes the vertical position, the pins connecting the screw block to the boom are taken out, and the boom is operated with the boom guide cable and winch placed on one side of the upper frame.

X-Ray Examination for Blow-Holes

Application of commercial X-ray apparatus to the detection of blow-holes in castings is described by E. Schneider in *Engineering* of May 9, 1919. Since the work was inaugurated at the laboratories of the Schneider-Le Creusot company researches have been made into segregation and blow-holes, and the influence of aluminum and of tungsten on steels. Examination of compound metals has been made. Castings up to 40 or 45-mm. (1.57- to 1.76-in.) thickness can be examined for blow-holes and internal defects. An example of the discovery of blow-holes forming in cast-steel brackets due to a defective method of casting is cited; by the changing of the casting process these blow-holes were eliminated. M. Schneider suggests the need for increasing the penetrative power of the apparatus to increase the scope of X-ray examination of metals to greater thicknesses.

Thickness of Concrete Slabs for Highway Surfaces

Maximum Loads, Condition of Subsoils, and Impact Are All Factors—Experiments Indicate the Latter Is Very Important

FROM extensive investigations of brick roads and tests for pressure upon the subgrade, engineers of the Bureau of Public Roads at Washington have concluded that while concrete-slab foundations and surfacings for roads should be proportioned with regard to maximum load and condition of subsoil, impact is a most important factor. Tentative conclusions from pressure tests indicate that tensile stress due to the road would be unlikely to break a slab which rests upon the subgrade, but that loads combined with impact will probably dictate slab thickness in such cases. Where the surface is arched and unsupported from any cause, direct bending stresses become important.

In recent issues of *Public Roads* two articles have been published, one dealing with the construction of brick pavements in the Middle West, by A. T. Goldbeck and F. H. Jackson, and one by Mr. Goldbeck, describing tests of the pressure of concrete slabs on the subsoil both loaded and unloaded. The articles appeared in Vol. I, Nos. 10 and 12, respectively, and the following information is abstacted from them.

The basis for the article upon brick roads was an inspection of a large number of pavements throughout the Middle West, with the idea of studying the merits of semimonolithic and monolithic brick roads. Other points affecting the design, such as the required thickness of base, the effect of soil conditions upon thickness, and the type of brick and filler to be used, were also considered. Particular attention was given to analyzing failures to determine the cause, so that suggestions might be made to guard against similar failures.

Soil Conditions Important

According to the authors, the character of the soil seemed to play a very important part in influencing the number of longitudinal cracks and the breaking down of many sections of pavement which were examined. It was very evident that sticky, clay soils, which retain a large amount of moisture and heave considerably during freezing and thawing weather, were much more likely to produce longitudinal cracks than were the more porous sandy soils. An instance examined where the road had broken entirely through, due to superimposed loads over a subgrade softened by the presence of moisture, was the Cleveland-Akron road. The writer suggests that soils of this character could be improved very greatly in their bearing value by the use of a porous filling material such as cinders, broken stone, slag and gravel, or by correct methods of drainage. In discussing the importance of soil conditions they state:

> It cannot be too strongly urged that a thorough study must be made of the underlying soil and the drainage conditions, before attempting to design a road for a particular locality. It should be noted, also, that certain kinds of soils are not susceptible of drainage by the methods ordinarily practiced, using tile drains and trench drains along the side of the road. It is apparent that capillarity plays a very strong part in influencing the retention of moisture by the subgrade, even though apparently good drainage facilities are provided. A thorough study of capillarity and methods of draining various kinds of soil would be of

great benefit. . . . The character and thickness of the base should be very largely governed by the local soil and traffic conditions. It should be emphasized very strongly that it cannot be considered good practice to make a standard design for a brick road and apply this design to all sections of the country, irrespective of these local conditions.

Thickness of Concrete Base

In considering the thickness of the concrete base under brick pavements, it is stated that a theoretical discussion is impossible, due to the lack of data regarding the reactions between the slab and the subsoil. The strength of the brick in the monolithic and semimonolithic slabs should be taken into consideration, as the entire slab acts as a beam. A perfect monolithic construction is desirable, and proper contact lugs and square edges on the brick, such as those of the wire-cut lug brick, are to be preferred. The results of the investigations show that the present-day heavy traffic can be carried safely on a 4-in. concrete base with 4-in. brick laid monolithic under favorable subgrade conditions. If a bituminous filler is used in the brick wearing surface, theoretically the concrete base should be thicker than in the case of a grouted surface. Absence of test data, however, makes it impossible to say how much thicker.

Conclusions

General conclusions were drawn by the authors as follows:

1. The type and thickness of base for any brick pavement should depend upon (a) the maximum weight of the loads to be carried, and (b) the bearing value, under all weather conditions, of the underlying soil.
2. In all cases where the traffic to be carried is likely to be heavy or where the underlying soil is of such a nature that its bearing value is not sufficient to support the pavement under all conditions, a concrete base of sufficient thickness to properly distribute the loads should be provided.
3. Where the maximum weight of the loads to be carried is not excessive and the subsoil is of a porous, well drained nature, the thickness of the concrete base may be decreased or under very favorable conditions, it may even be omitted altogether.
4. Other things being equal, a somewhat lighter construction may be permitted in the case of the monolithic and semimonolithic types than where the ordinary sand cushion type is provided, on account of the increased slab strength which these types appear to possess.
5. A concrete curb or edging is not necessary when monolithic or semimonolithic construction is used.
6. Paving brick with well formed contact lugs are to be preferred to brick without lugs.
7. Paving brick with square edges are to be preferred to brick with rounded edges.
8. Given the requisite care in construction, satisfactory results may be obtained with either cement grout or bituminous filler.
9. Vertical fiber lug brick with bituminous filler have given good service in those cities west of the Mississippi where they were inspected, possibly due to the protecting action of the asphalt mat which prevents wear from coming upon the brick direct.
10. Expansion joints in grout-filled pavements would seem advisable at street intersections and at points of tangency on curves, and longitudinal joints should be used against all rigid curbs or structures.

Tests For Soil Reactions Under Slabs

Further data upon the required thickness of concrete slabs are in process of determination as a result of experimentation by the Bureau of Public Roads, as mentioned above. The tests described by Mr. Goldbeck were made upon an 8-in. concrete wearing surface on the Camp A. A. Humphreys concrete road near Alexandria, Va.

Special pressure cells were designed for making the tests, and were placed as shown in Fig. 1. The cells were connected with a pressure gage at the side through a small pipe, and benchmarks were placed so that accurate measurements could be taken of the rise and fall of the slab under loading. The principle used in the device for measuring the pressure is that of (a) equilibrating the subgrade pressures against the exposed face of the measuring cells by means of air pressure within the cells; (b) detecting the instant that equilibrium takes place, by the breaking of an electrical contact within the cell, and (c) reading the air pressure on a delicate pressure gage connected with the air pipe leading to the cell.

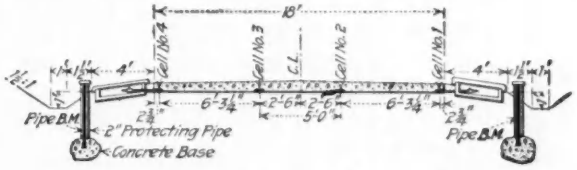


FIG. 1. CROSS-SECTION OF ROAD, SHOWING LOCATION OF PRESSURE CELLS AND APPARATUS

When taking pressure readings, an air hose leading from an air-pressure tank in the indicating box is connected with the ⅛-in. pipe leading to the cells. Electrical connections are made, one with the pipe, and the other with insulated wire inside the pipe. When the circuit is thus completed, a small electric light in the indicating box is lighted. Air is then allowed to escape from the pressure tank into the cell, and the air pressure within the cell gradually increases. When the pressure within the cell is slightly greater than the subgrade pressure on the cell, the diaphragm is moved, the electric contact is broken, extinguishing the light, and the air pressure is instantly read.

All of the pressure readings taken up to date with zero loading are shown on the curves in Fig. 2, reference to which reveals the fact that under zero load on the slab the reaction pressures under the slab are not uniform and are far from constant, varying from day to day. Readings taken before and after the passage of a heavy load showed very appreciable changes in pressure.

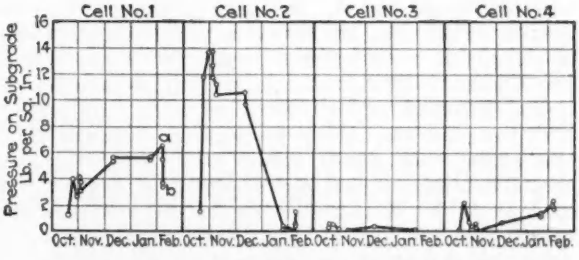


FIG. 2. CURVES OF PRESSURE READINGS AT ZERO LOADING

In order to determine the distribution of pressure under heavy wheel concentrations, a class B standard Army truck was loaded with five tons of sand. The front wheels and rear wheels of the loaded truck were weighed separately, and the axle loads were found to be 5000 lb. and 17,000 lb., respectively. The truck was

backed, 1 ft. at a time, up to the central measuring cells Nos. 2 and 3, beginning from a position beyond that at which the readings of the cells began to increase on account of the heavy load. This backing and pressure reading was continued until the front wheels were over the cell. In a second test the truck was backed

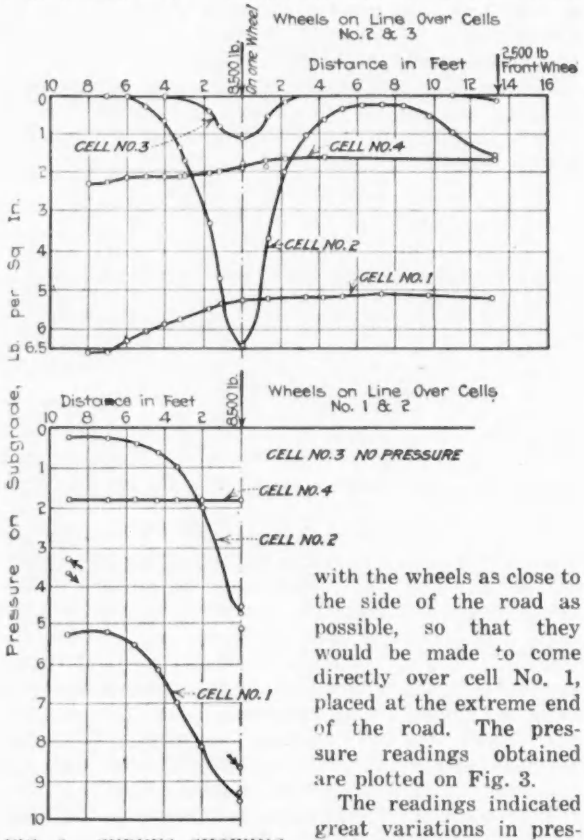

Wheels on Line Over Cells No. 2 & 3
8,500 lb. on one Wheel
Distance in Feet
2,500 lb Front Wheel
CELL NO. 3
CELL NO. 4
CELL NO. 2
CELL NO. 1
Lb. per Sq. In.
Pressure on Subgrade,
Wheels on Line Over Cells No. 1 & 2
CELL NO. 3 NO PRESSURE

FIG. 3. CURVES SHOWING DISTRIBUTION OF PRESSURES DUE TO WHEEL LOADS

with the wheels as close to the side of the road as possible, so that they would be made to come directly over cell No. 1, placed at the extreme end of the road. The pressure readings obtained are plotted on Fig. 3.

The readings indicated great variations in pressure. The greatest intensity is seen to be directly under the load, and decreases rapidly as the distance increases from the load. Cell No. 3 did not receive as much load as cell No. 2, owing to the arching of the concrete over the subgrade at this point. A considerable load was required to deflect the slab enough to bring it in contact with the subgrade. When the load was removed from this point of the slab it sprang back into shape away from the subgrade, so that no electrical contact was made in cell No. 3, thus showing that the subgrade was exerting no pressure at that point. It may be noted from Fig. 2 that, at the beginning of the test Feb. 5, the concrete slab was supported largely at its side, as indicated by the comparatively high readings on cells Nos. 1 and 4 and the zero readings on cells Nos. 2 and 3.

From the curves in Fig. 3 it is seen that a very close approximation to the actual intensities of the subgrade pressure may be made by considering them in the form of a cone of about 4-ft. radius, which approximates the curve for cell No. 2. Distributing the load over the base of a cone of this radius, considered as a plate, the pressures as figured by the author for a uniformly supported 8-in. slab showed little likelihood that the slab would be stressed excessively in bending due to static loads, as the pressure under an 8,500-lb. wheel load would not exceed 34 lb. per square inch.

Judging from the results obtained, the probability is that the tensile stress produced directly under the load will never influence the design of a road slab which rests on a fairly homogenous subgrade. If, however, conditions arise so that the slab is left entirely without support under the load, excessive tension can be developed. Upon the latter basis it was figured that for the most extreme cases, as in the case of cells Nos. 3 and 4, in order that a slab might be safe from cracking under a wheel load of 8500 lb. about a 12-in. thickness of concrete would be required. There was evidence that an arched condition might occur, from the fact that the subgrade would not react after deflection to the same extent as the slab, thus eliminating support.

The author emphasized the fact that in the present tests only static loads were considered, and that it is hard to believe that the many failures in slabs could have occurred under simple loading. It seems that impact must have a distinct effect in causing them.

Experimental Study of Side Launching by Fleet Corporation

MEASUREMENTS of side-launching phenomena will be made this week at Jacksonville by technical representatives of the Emergency Fleet Corporation. A 6000-ton steel ship will be launched on Aug. 2, 1919, at the Merrill-Stevens Co. yard, and it was desired to obtain from this launching data bearing on the water depth needed alongside the building berths. Immersion depth and degree of tipping are the primary data to be obtained, but precision observations of speed and acceleration during the time the ship is on the ways, and of water pressure after it leaves the ways, will also be carried out. The concrete ship section of the corporation, under jurisdiction of the Ship Construction Division, devised the instrumental equipment and will carry out the work.

It is planned to place four pressure recorders at either of two cross-sections of the ship (two on the forward bilge, one near the center keel, and the fourth on the rear bilge). Tipping will be measured by roll-recorders, checked by kinematographic exposures of a vertical scale attached to the vessel. Speed and acceleration data will be furnished by a combined time and travel record made by a modified "strainagraph" set on the deck and connected with a fixed point on land by a wire.

High Traffic Record on New Jersey Road

A traffic census taken during the past year on the Lincoln Highway near its crossing with the Passaic River in New Jersey showed, according to the annual report of the county engineer of Essex County, an average of about 5000 vehicles per day between 8 a.m. and 6 p.m., or one every 7 sec. Forty-five per cent. or 2250 of these were commercial cars. An average of 15,000 tons passed over the road daily; 80% of this was confined to a 40-ft. width of surfacing. This is equal to a loading of 300 tons per day per foot of driving width. In connection with this traffic, the great loss of time due to drawspans was brought out. The drawspan over the Passaic River was swung 9172 times, accumulating a traffic holdup of 39 days during the year. At the bridge over the Hackensack River, which is nearby, the draw was swung 3803 times, causing a loss in the utilization of the bridge of approximately 13 days.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

New Engineering Council or American Association of Engineers?

Sir—The suggestions of Dr. Charles Warren Hunt with reference to the membership and functions of local engineering associations, as quoted in *Engineering News-Record* of July 10, 1919, p. 87, are of considerable significance. Of particular interest is the statement that the existing national engineering societies should not be interfered with or hampered by being forced to undertake matters concerning the welfare of the profession, and that for that reason the problem arises as to how the engineers of the country may be organized to handle such matters.

Dr. Hunt's solution of the problem has so many points of similarity with the existing plan of the American Association of Engineers that one may rightly ask why Dr. Hunt does not rather advocate that the solution of the problem is for engineers to join the American Association of Engineers.

A brief comparison of Dr. Hunt's plan and the plan of the American Association of Engineers will be of value in determining the proper solution. The cardinal features of Dr. Hunt's plan are as follows:

1. That in each center of population there be formed a local engineering association to be known by some distinctive sectional name.

2. That the voting membership of each of these associations be limited to the members in any grade of any national society of engineers residing in the territory covered by the association—such membership not to be restricted to the four founder societies only.

3. That these associations (a) act upon all local matters and (b) elect their proportionate representation on a National Engineering Council and contribute in similar proportion to the support of that council.

In the plan actually in operation in the American Association of Engineers, the outstanding features are as follows:

1. In each center of population there already has been formed or is about to be formed a local chapter of the association—each chapter being known by a distinctive sectional name.

2. The voting membership of each of these chapters is open to all engineers possessing the necessary qualifications who reside in the territory covered by the chapter, and such membership is open to the members of the four founder societies and of any other engineering society who possess the requisite qualifications.

3. These chapters (a) act upon all local matters and (b) have a voice in the election of the national board of directors and contribute a definite proportion of their receipts to the support of the national headquarters of the association.

When the two plans are thus compared point for point, one is impressed by the striking similarity between them. It follows that the question which in reality presents itself to the minds of engineers for decision is whether their strength should be thrown in on the side of an existing successful organization or whether their strength should be used to set up in competition a new organization.

In my mind, the answer should be: (1) The national technical societies for the theoretical, scientific and educational questions. (2) The American Association of Engineers for all matters concerning the economic and social welfare of the profession.

KAY B. KNUDSEN,
Secretary, New York Chapter, A. A. E.
New York City.

Corps of Engineers and the Auxiliary Engineer Corps

Sir—Engineers will appreciate the frank statement of the Chief of Engineers, U. S. A., published in your issue of July 17, 1919, p. 141, concerning his attitude toward the bill designated S. 1376, Sixty-sixth Congress, First Session, providing for an Auxiliary Engineer Corps. His assurance that the Corps of Engineers has not interested itself in that bill is cordially accepted. So complete has been the cohesion of the Corps of Engineers and so loyal have its members been to the specifications of the organization, that it was but natural in the case of S. 1376 to assume that the old order had not changed, and that the attitude of certain engineer officers was, as in the past, the attitude of the organization. If such be not the case in this instance, we shall look forward with interest to the report that the War Department will make to the Senate concerning the measure in question.

The Chief of Engineers regards the bulletin of this conference, published in your issue of June 19, 1919, p. 1232, as an attack on the probity of the Corps of Engineers. No question of probity is involved. If the dictionary be correct, probity means honesty of purpose. If the Corps of Engineers, in its support of a legislative measure in its own interest, should inaugurate its campaign through the civilian employees in its district offices, there would be no dishonesty of purpose therein. Neither can an opponent's statement which purports to expose the genesis of such a campaign be called an attack on probity. If such were the case, practically every political campaign that the country has passed through would lack probity.

We recognize that this may be an appropriate time to interpret very frankly the attitude of the Conference on National Public Works toward the Corps of Engineers, as expressed in the writings and statements of thousands of civilian engineers throughout the country. This conference has entered on a campaign for the creation of a Department of Public Works. The Corps of Engineers now, as in the past, opposes this national reform because, as repeatedly and frankly stated by engineer officers, it involves the removal of our rivers and harbors work from military control This conference accepts the issue on that basis and will deal with it in a frank and open manner, undeterred by the familiar and oft-used plea of the Corps of Engineers that disagreement with it must constitute an attack on its probity. For more than forty years the civilian engineers of the country have listened to that sort of plea, rendered in so plausible, persuasive and courteous a way that civilian engineers have been

persuaded to turn from their effort, with the result that the Corps of Engineers has always triumphed.

We recognize that we have a strong, well organized antagonist in the Corps of Engineers, which is probably more potent in its hold on the national legislature than any other Federal organization. We also recognize that the opposition of the Corps of Engineers is a matter of self-preservation as opposed to the public welfare. While we expect success, it is obvious that we may be defeated. If defeated we shall rise again. Sooner or later the public interest will prevail, just as it has prevailed, in the matter of public-works administration, in all the other important countries of the world.

It will be the endeavor of this conference to avoid controversy concerning the fitness of the Corps of Engineers in civil work, and its performances in the past; but if said corps forces that issue upon us, we will reply as judicially and effectively as we can, dealing with facts—documentary evidence which occupies a large section of our file. We recognize the peculiar excellence of the Corps of Engineers in certain lines of its work, and many of its members excite our profound admiration. But such considerations are irrelevant. The administration of our Federal public works is now a veritable hodge-podge, the correction of which transcends all considerations of personal affection or of obeisance to an established organization, however ancient and honorable.

M. O. LEIGHTON,
Chairman, Engineers, Architects and Contractors' Conference on National Public Works.
Washington, D. C.

Regulate Engineering Profession by Law

Sir—I note the letter by F. N. Harris, of Olympia, Wash., which appeared in your issue of July 17, 1919, p. 141. I agree with Mr. Harris that the engineering profession needs a "closed season," but do not think there is any immediate danger of an oversupply of engineers from the engineering schools. I have been out of school since 1904, and in that time have met at least five hundred engineers, ranging from chainmen to chief engineers, and of that number not more than thirty or forty were graduates of an engineering school. Most of them were not graduates of a high school and some had studied only "the three R's."

What the engineering profession needs is regulation by law, the same as the medical, legal and other professions; then the profession and the individual members could command the respect of the public.

Coraopolis, Penn. F. E. CHESLEY.

Illinois Specifications for Monolithic Brick Roads

Sir—In view of the gross injustice that may ensue from the apparent misinterpretation of the results of tests on monolithic-brick slabs made at the University of Illinois, it seems necessary to restate a few of the fundamental principles enunciated as a result of these experiments. I refer particularly to the article by Clifford Older on new Illinois designs for rigid pavements, in *Engineering News-Record* of May 8, 1919, p. 905.

Mr. Older says that in a report of tests of monolithic slabs at the University of Illinois (see *Engineering News-Record* of Nov. 1, 1917, p. 802) Prof. C. C. Wiley states, in effect, that "the modulus of rupture of the concrete *base* of monolithic-brick slabs is approximately the same as that of plain concrete of the same quality, and that such slabs are fully equal in strength to concrete slabs of the same thickness."

But at no place in this article does Professor Wiley make the statement quoted. If by the last "same" is meant the concrete base, Mr. Wiley does say that, "these tests show that such a compound slab is fully equal in strength to a concrete road slab of the same thickness." Also, "with this type of construction it seems therefore entirely logical to reduce the total thickness of the slab, either by reducing the thickness of the base or by using thinner bricks, provided a sufficient gross thickness is retained to furnish strength enough to carry the probable loads, and this necessary gross thickness can be determined on the basis as the thickness of a concrete road."

Nor can it be said that these tests show that the concrete base of the monolithic slab must be of the same quality of concrete as in the all-concrete slab. The tests seem to show, for example, that a monolithic slab with a 1:3:5 concrete base is equal in strength to an all-concrete slab of a 1:2:3 mix.

Mr. Older's method of computing the required thicknesses for other mixes of concrete roads and other types of construction seems to be entirely justifiable. The question arises, Why should a designer go back for experimental data to a source which is over 15 years old? Later experiments give somewhat different results, and seem to fit more nearly the actual construction conditions as found today on the roads. It is quite probable that the experiments by William B. Fuller, referred to in Taylor and Thompson's book, were made on specimens of a much wetter consistency than the concrete which is to be used on the Illinois roads. The drier mixes, as shown by the experiments at the University of Illinois, and by the very elaborate and careful investigations of Prof. Duff A. Abrams, of Lewis Institute, give a much higher modulus of rupture for the leaner proportions.

After calculating the required thickness of a brick slab on the original basis of equivalent flexural strength, the designer proceeds to require the addition of 12½%, of material on the basis that, "If the total thickness is maintained the base would be so thin as to require a finer aggregate and more care in construction." What is the objection to the use of a finer aggregate? It is often cheaper, as it seems to be a size for which there is comparatively little demand. As to "more care required in construction," past experience seems to indicate that this is contrary to the facts; an example of which is to be found in the same issue of *Engineering News-Record* which is referred to above (Nov. 1, 1917, p. 830).

The specifications, as they now stand, require the brick pavement to contain 12½% more material by volume than the standard concrete pavement. This increased amount of material, together with the fact that the bricks are higher priced per unit volume than the concrete slab made of such materials as are readily available in the greater part of Illinois, results in a cost of construction which makes competition impossible. It should be remembered that the original premise was equal flexural strength. The addition of 12½% of

material adds more than 12½% to the flexural strength, as the variation in the first case is straight-line while in the latter it is parabolic.

The resulting brick pavement not only has greater strength, but greater wearing quality. There cannot be much ground for argument about this fact, in view of the statement that the limestone of the state is so soft that it is not fit for use in macadam roads. Such stone cannot become hard enough when mixed with a little cement to compare in wearing quality with vitrified brick.

Considering that a brick pavement has certain points of superiority which might justify its use in specific cases, even at considerable cost, it would seem that the proper policy would be to designate at once the type to be used, and call for bids on this only; rather than to call for competitive bids on two different types which obviously are not comparable on the basis of cost. As they are now written, the Illinois specifications have the effect, if not the appearance, of being discriminatory.

C. H. PIERSON.

Chicago, Ill.

[The foregoing letter was referred to Mr. Older, and his comment follows.—EDITOR.]

Sir—I believe Mr. Pierson will find, upon carefully reading Professor Wiley's article, contained in *Engineering News-Record* of Nov. 1, 1917, that Professor Wiley did say, *in effect*, "that the modulus of rupture of the concrete base of monolithic-brick slabs is approximately the same as that of plain concrete of the same quality." Professor Wiley's exact words were as follows:

"Comparison of the results given in the accompanying tabulation will show that when the concrete side of the slab is in tension the direction of the brick courses has little effect on the strength and that the modulus of rupture is approximately that of plain concrete of the same quality." [Page 821.]

I am unable to see how I misinterpreted this statement of Professor Wiley.

Mr. Pierson states that "the drier mixes, as shown by the experiments at the University of Illinois, and by the very elaborate and careful investigations of Prof. Duff A. Abrams, of Lewis Institute, give a much higher modulus of rupture for the leaner proportions." I am unfamiliar with any such tests, although I have a file of all of the Engineering Experiment Station bulletins, and referred to them, and also inquired personally of Professor Abrams for these data, previous to the preparation of my article. I would be glad if Mr. Pierson would refer me to the data in question.

I cannot agree that the brick pavement specified by Illinois has more flexural strength than the concrete slab specified. In the first place, only the 4-in. brick pavement has a greater thickness than the concrete slab. The 3-in. brick pavement specified has the same thickness and the same volume of materials.

Until sufficient tests are made to determine positively that the cross breaking strength of monolithic-brick slabs, having thicknesses of base equal at least to the thickness of the brick, and concrete of various proportions, is not the same as that of concrete slabs having the same thickness and the same proportions and quality of concrete, I can see no reasons for changing the designs selected.

A properly constructed brick pavement may present greater wear resistance than a concrete road having soft limestone aggregate. However, a concrete road built in Illinois, now six years old, constructed of aggregate showing a wearing coefficient of 6, exhibits such slight wear as to be negligible, although perhaps 75% of the traffic, which is moderately heavy, is steel-tired horse-drawn wagons.

As to the Illinois specifications being discriminatory, I cannot agree with Mr. Pierson except that they discriminate against inferior pavements of all types.

CLIFFORD OLDER,
Chief Highway Engineer, Department of Public
Springfield, Ill. Works and Buildings.

Appreciates Kindness of American Engineers

Sir—May I express through the columns of your valuable journal my keen appreciation of the kindness shown to me by brother engineers throughout the United States and Canada? During a tour of over three months, in which I have been studying some of the engineering problems of the cities of this continent, my daily contact with the members of the engineering profession has convinced me of their great value to the communities which they serve, and I have learned how closely are the ties that bind engineers of one country to another.

W. E. BUSH,
New York City. City Engineer, Auckland, N. Z.

A Plea for Making Watersheds and Administrative Areas Coincide

Sir—The plan and section of political administrative areas are of vital interest to the engineer. It is difficult to find any general principle underlying the present bewildering variety. The boundaries of all existing administrative areas—towns, counties, provinces, states, whole countries—bear all the marks of having been laid out from a map instead of on the ground. In new and unsurveyed country, the present system seems to be to take two parallels of latitude and two of longitude. This gives a neat and compact area, and, by analogous methods, you can, in a surprisingly short time, get a whole continent divided up into tidy and symmetrical parcels which will look extremely well on the office map. Whether they are likely to have any relation to flow of traffic or congruity of needs and occupations is a different matter. In well surveyed country, our boundary makers seem to have taken a river, a road and a canal—all of which are nicely marked on the map and on the ground. When the area looked big enough, they drew a straight line to close the polygon. From the scientific point of view both methods seem on a level.

In either case, after a lapse of time, many things happen in the usual course of nature. The merchant finds he cannot move his goods up river, down river or across the river. The farmer finds his crops are being ruined by floods or killed for lack of irrigation. The fisherman finds that factory waste is killing the fry. The manufacturer is starving for power. The man in the street wants to keep the dust down, drink pure water, and get rid of his sewage. Finally, when they get together and decide that something must be done, they find that, instead of having to get one public

authority to lay out a policy, pass the necessary ordinances, coerce obstructionists, and provide funds, they have to deal with four or five. And it is well known that the inertia of public bodies in the face of urgent public works increases as the *n*th power of the number of bodies involved.

The spectacle of two public authorities facing each other across a river, each waiting to see whether he can bluff the other fellow into paying for the essential bridge, is the lamentable but inevitable result of human nature under dual control. Nowadays, as a result of agitation and compromise, you find along any river a couple of irrigation boards, three or four drainage boards, a fishery conservation board, several water-supply and sewerage commissioners, and a couple of hydro-electric power companies. Each works in portions of several administrative areas. Their methods of collecting costs are cumbrous and expensive because duplicated by the areas. Their relations with each other and with the various authorities in whose areas they work are marked by veiled suspicion. This condition entails, in the aggregate, an inordinate amount of costly and intricate cross-account-keeping. And there is no coördinating power over this except the supreme power of the state, which is generally much too busy with matters of interest to all its constituents to worry over things which should be settled by the elected representatives of the people directly concerned.

Topographically, the ideal administrative area would be such that all matters affecting it arising from natural causes should be directly under its own undivided control. Among the most common and most costly of such matters are water-supply, sewerage, sewage discanalization, fisheries, river crossings—bridges, ferries, tunnels—navigation laws and ports. All these depend entirely upon the shape of the earth. All experience goes to show that when more than one authority is concerned with one of these matters, essential work is either not done, or is done after needless and ruinous delays. It seems obvious that the natural administrative area is the drainage area of a river, and its natural boundary a water parting.

All great cultures have grown up in river valleys—the Nile, the Euphrates, the Ganges. A river, far from being an obstacle, is generally an aid to communication. A mountain is always an obstacle. Even in war we know that, with proper engineering preparation and a good staff plan, a river crossing may cost some lives, but rarely loses much time; but you cannot make miles of road over a mountain in a night. In general, the inhabitants of a valley have a certain congruity of occupations, needs and interests.

If you can imagine people living on an ordinary pitch roof, you will see that the great mass live down near the gutter, and only a few daring spirits will climb up over the ridge to see what is in the other gutter. The direction of the great mass of traffic will be along the gutter, with perhaps one main route over the ridge to the other gutter. The people who live on the southern side, whose chief need is shade from the sun and extermination of the nesting swallows, will have no interest in the life of the northern inhabitants, who want warmth and shelter from the wind and rain. Our present system of taking rivers as boundaries and leaving a protruding backbone of watershed in the center of our areas to keep people apart results in a very similar state of things.

A system by which the complete drainage area of every river running into the sea would be administered by a single authority through sub-authorities in charge of the tributaries has much to recommend it. The electors who would have to vote on funds and policies would all be directly interested in them; for the rain falls on the just and the unjust alike, and then prefers to run downhill. The hordes of artificial and overlapping boards would disappear. Their boundaries would become coincident with those of the administrative area. The cost of their complicated accountancy would be saved. Their functions would be carried out with much greater efficiency and freer initiative by the area's public-works commission. Concerted action in matters of public interest would become much easier. The electors interested in any improvement would only have to tell their representatives to get on with it; there would be no other authority to worry.

The allotment of costs would be greatly simplified. The administrative authority could map out the lines of its internal traffic for the highest degree of efficiency, spot accurately the transfer points for external traffic, and fix and plan its port to handle all the imports and exports of the valley. It could coördinate its drainage, its irrigation, and its power. It could make its water-supply, its sewerage and its fishery live in amity. It could do all these because they were all of direct interest to all its constituents, and of no interest whatsoever to any one else.

C. G. LYNAM,
Major, Royal Engineers, British Expeditionary Force.

Using Planimeter to Compute Earthwork

Sir—I have read with interest the letter by Prof. J. H. Dorroh of the University of Mississippi in your issue of July 3, 1919, p. 39, concerning advantages claimed for the use of a special cross-section paper in computing earthwork. The paper used by Professor Dorroh was to the scale of 1 in. = $\sqrt{27}$ ft. = 5.196, so that 1 in. would equal 27 sq.ft. and it was claimed that "the use of this paper saves the time ordinarily spent in reducing square inches to square feet and cubic feet to cubic yards, as required with other cross-section papers."

The writer has been employed in several engineering offices where it is customary to obtain all areas by the planimeter in square inches and then reduce to square feet or some other unit. The work of reduction from one unit to another can usually be avoided.

It is a simple matter to compute a setting of the tracer arm of the planimeter for any paper or scale of plotting which will give results in feet or in any other unit desired. Where much of this work has to be done, valuable time can be saved by having on hand a list of settings for various scales and units. I have found this method especially valuable in the case of maps where areas can be obtained directly in acres or square miles instead of in square inches or square feet.

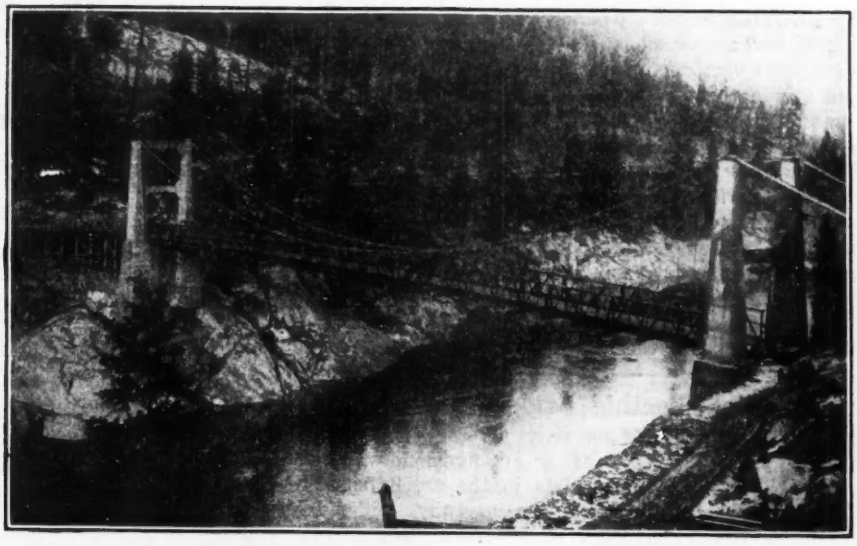
It is not always possible to plot all cross-sections to the same scale or to multiples of that scale. All paper, especially blueprint paper, is subject to distortion which varies with different conditions of temperature and moisture and which should be taken into consideration with areas of more than a few square inches. By a slight adjustment of the planimeter it is usually possible to correct these errors.

L. C. CRAIG,
Edmund T. Perkins Engineering Company.
Chicago, Ill.

Erecting a 331-Foot Suspension Bridge With Unskilled Labor

Sir—The article by William G. Grove in *Engineering News-Record* of July 3, 1919, p. 4, describing a 540-ft. suspension bridge, recalls a somewhat similar but smaller structure built at Brilliant, B. C., in 1913. This was for the Doukhobor society, composed of Russian peasants of a religious sect, living under a system of community ownership, so that the organization customary on construction work did not exist. Very few of them could talk any English, and I knew nothing of their language till I learned it on the job.

The bridge has a span of 331 ft. between centers of towers, with a 16-ft. roadway. The trusses are of steel, 9 ft. deep; the floor-beams are pairs of channels with hanger rods between and a kneebrace at each end. The towers are 50 ft. high above the piers and are of reinforced concrete. Each cable consists of four plow-steel wire ropes 2 in. in diameter, with about 37-ft. sag, this arrangement being adopted in order to use cables which the Doukhobors had bought before engaging engineers. Each rope socket is attached to two 2¼-in. rods which pass through a steel anchor bedded in concrete in the solid granite. At the towers, the cables rest on saddles, under which are rollers. The cables are cradled in planes with a batter of 1 to 12 and there are 1⅜-in. guy cables on each side, attached to floor-beams.



SUSPENSION BRIDGE AT BRILLIANT, B. C.

As the men were not accustomed to working high in the air, considerable difficulty was experienced in getting them to try some of the operations. On the north side of the river a 95-ft. tower was needed for hoisting concrete. Only three men were willing to build it, and even they would not take it down afterward, so it was pulled over and smashed on the rocks.

The cables were pulled across the river supported on a trolley cable, and after being swung free were adjusted to length. For placing clamps and hanger rods, a trolley cable was used on each side of the road; on these were hung boxes in which the men worked. For entering the lower ends of hanger rods through the floor-beams, suspended chairs were used. All of the men working on steel erection wore safety belts, such as are used by telephone linemen. On one side of the river the steel was lifted by a small single-drum engine; on the other side hand tackle was used.

After the clamps were on the cables the method used was as follows: Hanger rods were put up for three panels; then three floor-beams with kneebraces attached were hung, after which the trusses in the three panel sections were put on. A couple of holes in the top chord splice were then caught, the bottom chords pulled together, and the diagonal put in. Then after the laterals were put in place the deck was extended. Bolts were used for field connections.

PLACING A THREE-PANEL SECTION OF SUSPENSION BRIDGE

The bridge was built by the Doukhobor society, assisted financially by the provincial Government of British Columbia. It was designed by John R. Grant, of Cartwright, Matheson & Co., of Vancouver, B. C.; the writer was in charge of construction for the same firm.

A. M. TRUESDELL,
American Bridge Co.
Gary, Ind.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Bottom Form Carries Ginpole to Erect Top Form

ERECTION of the top panels of end forms for a retaining wall at Columbus, Ohio, is facilitated by using as a ginpole a vertical timber which serves to bind together and stiffen the two panels when erected. The wall is some 7 ft. thick at the base, 2 ft. thick under the coping and 25 ft. high, and is being concreted in 30-ft. sections. Frequent erection of the end forms is necessary, due to the construction in sections, and, because of the height of the wall and of the design of the panels for repeated use, they are heavy. The bottom panel and the vertical stiffener are first erected; then, using the vertical stiffener as a ginpole, the top panel is erected. D. W. McGrath & Sons, Columbus, Ohio, are the contractors and W. A. Jones is their superintendent.

Steel Sheeting Bridges Trench

FOR carrying streets and roads across trenches where steel sheet piling is used, an arrangement which requires but little depth consists in the use of some of the spare sheeting to form the roadway. Piles laid across the trench support a platform composed of piles parallel with the trench, this platform being covered with a few inches of earth. For light traffic a single layer of sheeting across the trench may suffice.

This construction is said to be superior to the ordinary plank platform or roadway, the planks of which wear and split under traffic, while the sheeting remains practically uninjured and may be used many times. It was devised by A. J. Penote, contractor, Cleveland, Ohio.

Raising a 140-Foot Concreting Tower Into Place in One Piece

BY S. S. HAMMEL
Assistant District Manager The Foundation Co., Pittsburgh, Penn.

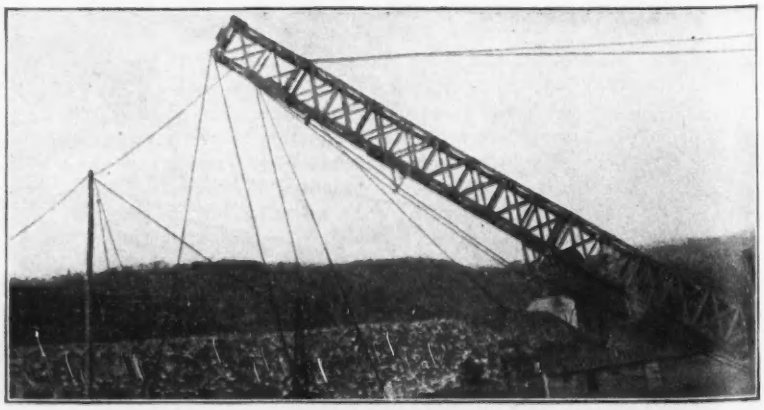
POSSIBLE interference of guy lines with the excavating and piledriving operations in the construction of a marine way for the Carnegie Steel Co. at Coal valley, Penn., forced the contractor to raise complete in one piece the 140-ft. wooden concreting tower which was required in subsequent concreting work. The tower-raising operation is shown in the accompanying view.

A permanent foundation for the tower was built in its proper place, made up mainly of two long timbers laid on the ground and anchored firmly with a spacing equal to the width of the tower. Two more timbers were laid across these and bolted to the first two to serve as the horizontal legs which were used in the tower in place of guys. The tower was then built up horizontally and laid along a line normal to the shore line, with its base tight against the foundation timbers, which were used also as a heel of the raising. To stiffen the tower in the raising operation steel cables were trussed as shown in the view along the lower side.

A heavy ginpole 50 ft. high was then set up at the shore end of the tower, and lines were rigged with block and fall to the top of the tower. When the time came for raising, two derrick boats with 75-ft. booms were set at the shore line, and boomed up as high as possible.

The fall lines from these derricks were made fast to a timber that was placed near the top of the tower so as to distribute the strain. The tower was first raised by means of the ginpole until it had made an angle of about 20° with the horizontal, when the derrick boats took the strain. Block and falls from the ginpole were then cut loose, and the tower was raised to its vertical position by the derrick boats. During the raising, the guys which had been made fast to the top of the tower while lying down were paid out from snubbing posts and kept tight enough to hold the tower in line in the line of the derricks. Exactly 35 min. elapsed from the time when the tower left its horizontal position until it was erect in place.

The work was done from the Pittsburgh office of the Foundation Co., of which H. B. Kelsey is district manager.



140-FOOT WOODEN CONCRETING TOWER BEING LIFTED INTACT INTO POSITION

Other Articles in This Issue of Interest to Contractors:

Substructure of Michigan Avenue Bascule Bridge, Chicago — Page 210
Camp Beds and Bedding Service Reduce Labor Turnover — Page 213
Chicago's $140,000,000 Lake-Front Improvement Plans — Page 216
Haul Gravel With Caterpillar Tractor in Minnesota — Page 227
Mounted Piledriver Rig Developed by United States Army — Page 232

NEWS OF THE WEEK

New York, July 31, 1919

Massachusetts Water-Supply Problems To Be Studied

An investigation of the water-supply needs and resources of Massachusetts is to be made jointly by the State Department of Health and the Metropolitan Water and Sewerage Board, under a recent act of the legislature. (Chap. 49, Laws of 1919.) The investigation is to include "all questions relating to the quantity of water to be obtained from available sources, its quality, the best methods of protecting the purity of the water, the construction, operation and maintenance of works for storing, conveying and purifying the water, the cost of the same, the damages to property, and all matters pertaining to the subject."

A report is to be made to the legislature by the first Wednesday in January, 1921. A general organization for the study has been effected. *Engineering News-Record* is informed by X. H. Goodnough, chief engineer of the State Department of Health, that besides the needs of Boston and vicinity for more water, before many years consideration must be given to the water-supply problems of cities in southeastern Massachusetts, in the Merrimack and the Ipswich Valleys and in other thickly populated areas to the west and south of the present Metropolitan district.

Illinois Architects' License Law

Registration and licensing of architects in Illinois are provided by a new state law amending previous laws and specifically permitting licensed architects to enter into partnership with licensed structural engineers. A company engaged in architectural work may not be licensed, but must have a registered architect at its head.

This law does not affect draftsmen and superintendents acting under the supervision of registered architects, but persons registered under this law are exempt from the provisions of laws regulating the practice of structural engineering. It does not apply to residential or farm structures outside of corporate limits or to structures costing not over $7500 within such limits.

Examinations for license will cover design and construction, sanitation and ventilation, strength of building materials, and the ability of the applicant. The law describes a "building" as follows: "A building is any structure consisting of foundations, floors, walls, columns, girders, beams and roof, or a combination of any number of these parts, with or without other parts."

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.,

New York Wants Full Control of Barge Canal Rates

Governor Smith of New York has written to the New York members of Congress asking them to assist in defeating an attempt now before Congress to amend the Interstate Commerce Law by giving the Interstate Commerce Commission regulation and control of canal transportation rates. The Governor contends that the ratemaking power should remain with the carriers, and that if the bill now under consideration became law the Interstate Commerce Commission could order the publication of rates via a water route on an equality with rail routes from interior points or establish water rates at such a small differential under the rail rate that the traffic would be diverted from the water route. In this manner, he says, the competitive influence of the waterway might be nullified, and the expenditure of over $150,000,000 go for naught.

Garbage Disposal at St. Louis

Hearings on garbage disposal, preliminary to drafting specifications for bids, are being held by the Board of Public Service of St. Louis, Mo. The present temporary contract for disposal by feeding to hogs will expire in May, 1920. Alternative bids on feeding and on reduction may be invited.

United States May Build Largest Ocean Steamers

Announcement has been made by the United States Shipping Board that it is planning to build, as speedily as possible, two mammoth ocean liners, the largest and fastest in the world, for the transatlantic trade, and that it is considering recommending the revival of the Montauk Point terminal scheme for a landing place for these steamers.

Chairman Hurley of the Shipping Board has asked the Navy Department to supervise the building of these vessels, under the direction of a joint committee composed of Admiral D. W. Taylor, chief of the Bureau of Construction of the Navy, as chairman, and the presidents of several of the largest shipbuilding companies. According to the announcement, each of the ships will be 1000 ft. long and have 102 ft. beam, with a draft of 35 ft., a gross tonnage of 55,000 and an engine power of 110,000 hp., capable of giving a 30-knot speed. The vessels are to be passenger liners purely, with accommodations for 1000 saloon passengers, 800 second cabin, and 1200 steerage passengers. As planned, they will be somewhat larger than the "Leviathan," the former German liner "Vaterland," which is 950 ft. long, with 100 ft. beam. The new vessels will be oil-burning and have an oil-carrying capacity giving them a steaming radius of 7000 miles, so that they would be able to make a rapid turnaround at the other side.

The Montauk Point terminal scheme was suggested nearly 30 years ago by Austin Corbin, then president of the Long Island R.R. It contemplates the building of large terminal and docking facilities at Fort Pond, at the extreme eastern end of Long Island, and the double-tracking of the Long Island R.R. clear to New York. This line is about 120 miles long, and would reduce the steamship passage to Europe by that distance. It is expected that with the new vessels the time from the end of Long Island to Plymouth would be reduced to four days.

Permanent Housing Bureau Proposed

A bill has been introduced into the House of Representatives by Mr. Tinkham, of Massachusetts, to create a bureau of housing and living conditions in the United States Department of Labor. This bill proposes that this new bureau should be charged with the duty of investigating the housing and living conditions of the industrial population, conducting research and experimentation looking toward the provision

and publication of such information as will make economically practicable the elimination of slums, etc.; assisting communities during the present housing shortage; making available to the utmost all existing housing facilities, and serving as a clearing house of information on housing and living conditions.

It is further provided that the bureau shall inherit the collections of plans, books, pamphlets, etc., gathered by the United States Housing Corporation and by the housing and transportation division of the Emergency Fleet Corporation. A director is provided at a compensation of $6000 a year, and an annual appropriation of $250,000 is made. The bill has been referred to the Committee on Public Buildings and Grounds.

Going Ahead With Water Filters for Sacramento

Bonds for $1,800,000 for a 30,000,000-gal. mechanical water filtration plant for Sacramento, Calif., are about to be issued, following authorization by popular vote in June, 1919. Charles Gilman Hyde, professor of sanitary engineering, University of California, Berkeley, Calif., has been engaged as consulting engineer.

New York Council of Federal Highway Council Organized

New York State representatives of the Federal Highway Council met in the United Engineering Societies Building, New York City, July 18, 1919, and organized a New York State Council. The object of forming the council is to obtain the enactment by Congress of Federal legislation embodying the principles set forth in the Townsend bill providing for the creation of a Federal Highway Commission and the construction and control by the United States Government of a system of national highways. To assist in accomplishing this object, there will be appointed county representatives of the council throughout the State of New York. They will be instructed to obtain support of the Townsend bill by local organizations. The following officers were elected:

Chairman, Arthur H. Blanchard, president of the American Roadbuilders' Association and National Highway Traffic Association; vice-chairmen, D. C. Fenner, past-president of the Motor Truck Association of America; George M. Graham, manager of the Pierce-Arrow Motor Car Company; the Hon. Frederick S. Greene, New York State commissioner of highways; Edward J. Mehren, editor of *Engineering News-Record*, and Lt. Col. Theodore Roosevelt; secretary and treasurer, H. W. Perry, manager of the Trailer Manufacturers' Association of America.

New Hetch Hetchy Dam To Be One of Highest in World

Bids are now being asked by the Department of Public Works of San Francisco, Calif., through M. M. O'Shaughnessy, city engineer, for the construction of the Hetch Hetchy dam for the new city water-supply. When completed this will be one of the large masonry dams of the world. From the crest of the dam to the lowest estimate excavation is 311 ft., with a height above stream level of 212 ft., and an average excavation of 72 ft. Provision is made, however, for future enlargement. It will be a straight cyclopean masonry gravity-section dam 600 ft. long, with either a siphon spillway or an overflow section provided with Tainter gates, as later to be determined. Figures given in the advertisement for bids are as follows: Excavation below stream level, 77,000 cu.yd.; excavation above stream level, 60,500 cu.yd.; cyclopean masonry, 298,800 cu.yd., other concrete, 66,850 cu.yd.

The dam site is on the Tuolumne River about 150 miles east of San Francisco, and some 3600 ft. higher.

Highway Financing Status Throughout the United States

A compilation of the amounts of highway bond issues voted, to be voted, and contemplated in the United States is shown in the table herewith. Various sources of information have been utilized in preparing this table, principally data received from the Portland Cement Association.

In rating moneys voted in states not utilizing bond issues, the funds made available have in several cases been substituted and added to the bond issues. Under "election pending," elections by vote of legislators, commissioners and the people direct have all been included. No account has been taken of the large appopriations made by the Government for Federal aid.

This list is changing daily as various places vote upon the propositions, and a summary made later in the year will show quite different results. However, it is felt that the large figures recorded show the strong trend toward intensive road construction throughout the country.

FUNDS PROVIDED, TO BE VOTED UPON AND CONTEMPLATED FOR HIGHWAY CONSTRUCTION IN UNITED STATES

State	State Highway Funds			County Highway Funds				Totals			Grand Total
	Voted	Election Pending	Contemplated	No.	Voted	Election Pending	Contemplated	Voted	Election Pending	Contemplated	
Alabama				1		$5,000,000			$5,000,000		$5,000,000
Arizona				4	4,200,000	1,200,000	500,000	4,200,000	1,200,000	500,000	5,900,000
Arkansas			15,000,000	2	50,000,000			50,000,000		15,000,000	65,000,000
California	40,000,000			5	7,690,000	3,500,000		47,690,000	3,500,000		51,190,000
Colorado		5,000,000							5,000,000		5,000,000
Delaware				2		890,000			890,000		890,000
Georgia			40,000,000	46	7,088,000	9,323,000	1,440,000	7,088,000	9,323,000	41,440,000	57,851,000
Idaho				15	2,400,000	1,930,000		2,400,000	1,930,000		4,330,000
Illinois	60,000,000			7	1,095,800		600,000	61,095,800		600,000	61,695,800
Iowa				4	3,500,000	4,750,000		3,500,000	4,750,000		8,250,000
Kansas			60,000,000	..						60,000,000	60,000,000
Louisiana				..	1,805,000	4,190,000		1,805,000	4,190,000		5,995,000
Maine		8,000,000		..					8,000,000		8,000,000
Maryland	3,000,000			..				3,000,000			3,000,000
Michigan	50,000,000			..	1,400,000			51,400,000			51,400,000
Minnesota		100,000,000		..		7,500,000			107,500,000		107,500,000
Mississippi			20,000,000	..	5,650,000	3,030,000		5,650,000	3,030,000	20,000,000	28,680,000
Missouri		60,000,000		..	2,504,000	625,000	2,100,000	2,504,000	60,625,000	2,100,000	65,229,000
Montana		15,000,000		..	400,000	150,000	250,000	400,000	15,150,000	250,000	15,800,000
Nebraska				1			3,000,000			3,000,000	3,000,000
Nevada	1,000,000			..				1,000,000			1,000,000
New Jersey	5,000,000			1			605,000	5,000,000		605,000	5,605,000
New Mexico	500,000		5,500,000	..				500,000		5,500,000	6,000,000
New York		20,000,000		..					20,000,000		20,000,000
North Carolina	1,250,000		25,000,000	7	3,180,000	500,000	2,000,000	4,430,000	500,000	27,000,000	31,930,000
North Dakota			50,000,000	..						50,000,000	50,000,000
Oklahoma				2	150,000	60,000		158,000	60,000		218,000
Oregon	12,500,000			22	6,095,000	794,000		18,595,000	794,000		19,389,000
Pennsylvania	50,000,000			17	5,950,000	1,650,000	9,000,000	55,950,000	1,650,000	9,000,000	66,600,000
South Carolina			25,000,000	4	2,625,000	2,060,000		2,625,000	2,060,000	25,000,000	29,685,000
South Dakota				2		2,500,000	2,000,000		2,500,000	2,000,000	4,500,000
Tennessee			50,000,000							50,000,000	50,000,000
Texas		75,000,000		61	35,680,000	14,180,000	15,750,000	35,680,000	89,180,000	15,750,000	140,610,000
Utah		4,000,000		2	1,500,000	850,000		1,500,000	4,850,000		6,350,000
Virginia	3,100,000			1		114,000		3,100,000	114,000		3,214,000
Washington		30,000,000		7	8,540,000	250,000	3,200,000	8,540,000	30,250,000	3,200,000	41,990,000
West Virginia		50,000,000		23	2,200,000	2,935,000	8,936,000	2,200,000	52,935,000	8,936,000	64,071,000
Wisconsin	10,210,000		50,000,000	7	1,952,000	5,850,000	6,000,000	12,162,000	5,850,000	56,000,000	74,012,000
Wyoming	2,900,000							2,900,000			2,900,000
Totals	239,460,000	367,000,000	340,500,000		155,612,800	73,831,000	55,381,000	395,072,800	440,831,000	395,881,000	1,231,784,800

Motor Vehicle and Material Allotments

Department of Agriculture Reports to Congress on Distribution of Large Quantities

Large amounts of equipment and materials from the surplus of war supplies not needed by the War Department have been and are being distributed by the Department of Agriculture through the Bureau of Public Roads, according to a report made to Congress by the Department of Agriculture. This equipment and material is included under general heads as follows: Motor trucks and motor cars; construction and operating equipment; construction materials; field and office equipment; camp, mess and kitchen equipment; general supplies, machine tools, woodworking tools and miscellaneous outfits, and animals.

Aggregate Value Very Large

The aggregate value of the items under these heads is very large, the value of the motor-truck equipment alone being estimated at more than $70,000,000. The equipment and supplies are being distributed under an act of Congress which instructed the Secretary of War to deliver surplus war materials to the Department of Agriculture to be used in the construction and maintenance of roads constructed in part or in whole by Federal aid. This material is allotted to the states on the same basis as Federal aid and represents an addition to the Federal aid given by the various Federal-aid appropriations.

Allotments of motor vehicles are now reported by the Secretary of Agriculture to be complete; these allotments to the various states are given in the table printed herewith. Large numbers of these trucks and other motor vehicles have already been shipped to the states concerned.

ALLOTMENTS OF MOTOR VEHICLES FOR FEDERAL-AID ROAD WORK BY BUREAU OF PUBLIC ROADS

	Trucks	Fords	Autos
Alabama	432	21	11
Arizona	282	14	6
Arkansas	343	17	8
California	622	30	15
Colorado	358	17	9
Connecticut	124	6	4
Delaware	34	2	1
Florida	236	11	6
Georgia	553	27	4
Idaho	251	12	6
Illinois	898	44	22
Indiana	556	27	14
Iowa	595	29	15
Kansas	593	29	15
Kentucky	400	19	10
Louisiana	280	14	7
Maine	196	10	5
Maryland	181	9	4
Massachusetts	303	15	7
Michigan	596	29	15
Minnesota	584	28	14
Mississippi	366	18	9
Missouri	697	34	17
Montana	413	20	10
Nebraska	440	21	11
Nevada	265	13	7
New Hampshire	83	4	2
New Jersey	245	12	6
New Mexico	321	16	8
New York	1,021	50	25
North Carolina	470	23	12
North Dakota	319	15	8
Ohio	761	37	19
Oklahoma	476	23	12
Oregon	326	16	8
Pennsylvania	942	46	23
Rhode Island	48	2	1
South Carolina	296	14	8
South Dakota	333	16	9
Tennessee	462	22	11
Texas	1,199	58	30
Utah	237	11	6
Vermont	95	5	3
Virginia	406	20	10
Washington	298	14	7
West Virginia	217	11	5
Wisconsin	557	25	13
Wyoming	252	12	7
Forestry	118	32	....
Public Roads	506	75	55
Totals	20,586	1,075	550

Other Materials Being Delivered to Agriculture Department

Construction and Operating Equipment—The materials under the other headings are being delivered to the Department of Agriculture as rapidly as possible, and an attempt is to be made by the Secretary of War to cover the estimated needs of the various state highway departments as given to him by the Secretary of Agriculture. The estimate of construction and operating equipment includes such items as road rollers, 400; concrete mixers, 700; road graders, 600; elevating graders, 400; sprinkling wagons, 400; road oilers, 200; trailers and tractors, 3600; dump wagons, 6500; industrial railway dump cars, 3500, and 1000 miles of industrial-railway track. The total number of items included under this heading is 52.

Construction Material—Under the head of construction materials there are such items as the following: Bituminous binder, 550,000 barrels; lineal feet of prepared joint filler, 50,000; bags of portland cement, 2,110,000; tons of gravel and crushed stone, each, 1,000,000; lineal feet of steel forms, 40,000; industrial-railroad ties, 674,000; lineal feet of cast-iron culvert pipe, from 12 to 36 in. in diameter, 56,025, and 10,000,000 lb. of TNT (trinitrotoluene). Under this heading 31 items appear.

Field and Office Equipment—Listed as field and office equipment are 40 items, among which are engineers' transits, 1000; engineers' levels, 1146; Abney's levels, 1188; Universal drafting machines, 228; planimeters, 592, and 366 adding machines.

Camp Mess and Kitchen Equipment—Under the head of camp mess and kitchen equipment 11 items occur, such as tents, 17,000; Army blankets, 25,100; square feet of tarpaulin, 316,000, and 460 complete outfits of mess and kitchen equipment for units of various sizes, averaging 40 men.

As general supplies there are 40 items, one of which is 63,000 shovels, and under machine tools, woodworking tools and miscellaneous outfits there are 18 items, among which are complete machine outfits, 15; complete sets of carpenters' tools and chests, 306, and 552 complete sets of blacksmiths' outfits with forges, drills and other accessories.

Contributions From Engineers, Architects and Constructors' Conference on National Public Works

M. O. Leighton, Chairman

Publisher's Note: *The space occupied under this caption is donated to serve as a means of frequent and intimate communication between the Engineers, Architects and Constructors' Conference on National Public Works and the members of the profession. The contributor takes full authority for the statements made.*

Public Works Departments in Other Countries

Those who urge the creation of a national Department of Public Works in the United States are merely contending that our affairs should be managed in the way which practically all the modern world, except this country, has found necessary. Without going into details concerning the various laws of foreign countries, it will be of interest to mention their names and the general characteristics of their public-works departments.

Canada—A Ministry of Public Works presiding over the Department of Public Works, with a suitable staff of deputies, engineers, architects, etc., has control over rivers, harbors, and all hydraulic works, roads, bridges, public buildings, telegraph lines, and surveys.

Australia—A parliamentary committee of nine constitutes a standing committee of public works.

New Zealand—Has the most comprehensive public-works code in existence, presided over by a Minister of Public Works whose jurisdiction includes lands, and eminent domain concerning the same; roads, surveys, bridges, ferries, rivers, railways, drainage, water-supply, mining, water power and irrigation.

France—A Ministry of Public Works covering roads and traffic regulations, river and maritime navigation, water power, drainage, irrigation, railroads, mines, public buildings and public monuments.

Spain—A Ministry of Public Works covering roads, railways, waters, rivers, canals, ports, mining and forestry.

Italy—A Ministry of Public Works, with jurisdiction over postoffices, railways, public buildings, bridges, monuments, prisons, fuel, storehouses, telegraphs, internal navigation, water storage, irrigation, drainage, floods, lighthouses, water power and climatology.

Denmark.—A Department of Public Works having jurisdiction over buildings, roads, rivers, harbors, water power, drainage, dikes, ferries, railroads, telegraphs and telephones, postal affairs and transportation. It is of interest to note that this Department of Public Works was, by royal decree of Apr. 27, 1900, set up by a division of the Department of the Interior in much the same way as is now proposed for the United States by the Engineers, Architects' and Constructors' Conference on National Public Works.

Norway—A Department of Public Works, made by division from the De-

partment of the Interior, with jurisdiction over highways, rivers, railroads, fire insurance, harbors, postal affairs, technical schools and surveys.

Prussia—A Ministry of Public Works with jurisdiction over coasts, harbors, lighthouses, merchant marine, waterways, public buildings, railroads, highways, monuments, postal service, telegraphs and telephones, rivers, lakes, canals, drainage and hydraulic works.

Argentina—A Department of Public Works embracing all enterprise and works concerning means of communication, hydraulic works, all construction—either of architectural or other nature—including public buildings, monuments, churches, prisons, barracks, arsenals, forts, shipyards, lighthouses, roads and bridges, and all hydraulic and sanitary matters.

Brazil—A Department of Communication and Public Works having jurisdiction over railroads, highways, interior navigation, ports, rivers and canals, water-supply, water power and surveys.

Chili—A Department of Industry and Public Works having jurisdiction over all communications by land, river and sea, the utilization and distribution of waters, public buildings, mines, surveys and mappings.

Peru — A Department of Public Works, formerly a part of the Ministry of the Interior, having jurisdiction over irrigation, hygiene, mines, schools, patents and trademarks, waterways and state railways.

England — The Commissioners of Works and Public Buildings have control over the lands and buildings of all kinds belonging to the Government, while rivers and harbors and their appurtenances are under the jurisdiction of the Board of Trade. This is the only modern government of any size, except the United States, in which all government activities of this kind are not concentrated under one jurisdiction.

Detailed information concerning the public-works laws of any of the countries above mentioned can be obtained on application to the Washington office of this conference.

Minnesota To Correlate Schools of Chemistry and Engineering

Lauder W. Jones, dean of the school of chemistry, has been elected to the deanship of the college of engineering at the University of Minnesota to fill the vacancy created when Dean John R. Allen resigned July 1. According to President M. L. Burton, the plan of the university is to correlate all the work in the engineering field, although the school of chemistry and the college of engineering and architecture, despite the unified administration, will continue their separate existence.

Dean Jones went to the University of Minnesota last year from the University of Cincinnati, where for 11 years he was head of the department of chemical engineering and director of the work in metallurgical engineering.

Imhoff Tanks and Percolating Filters for Worcester

Plans for extensive additions to the sewage-works of Worcester, Mass., are being made under the direction of F. A. McClure, city engineer. It is expected that the work will be done by the day, under the direction of Matthew Gault, superintendent of sewers. Under the provisions of Chapter 171, Massachusetts Laws, 1919, which were agreed to by the officials of the City of Worcester, by representatives of the towns in the Blackstone Valley, below the Worcester sewage-works, and by the State Department of Health, the city must begin construction of the proposed additions by Oct. 1, in accordance with plans to be approved by the department, and must complete the additions by April 1, 1924. By April 1, 1920, the city must have spent at least $100,000 on this work, and thereafter it must spend at least $200,000 yearly until the new plant is completed. The works must be of such a character as to remove from the sewage of the city, "before its discharge into the Blackstone River, the offensive and polluting properties and substances therein, so that after" the discharge of the sewage into the river "it shall not create a nuisance or endanger the public health."

The plans as now being made by Mr. McClure are designed to care for the sewage of the city at least until 1934. They provide for a minimum night flow of 14,000,000 gal. and a maximum flow of 60,000,000 gal. for short periods. The first installation will probably consist of 20 Imhoff tanks, 6 pairs of dosing tanks, 14 acres of stone percolating or trickling filters, and a final settling tank. These works will be located about a mile below the present plant, necessitating a sewer outfall extension of that length, and the lowering of the bed of the Blackstone River for about one-fourth mile.

It is expected that the existing 16 chemical precipitation tanks and 77 acres of sand filters will be used for treating storm water.

The decision to use Imhoff tanks follows after a long series of tests of various methods of disposal, including the activated-sludge process.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Electrical assistant, signal service at large, War Department, for duty at Manila, Philippine Islands, $1500 to $2000 per year. Applications must be filed before the close of business on Aug. 19.

Technical assistant, field of civil engineering, $3200 per year, and technical assistant, torpedo design, $3000 per year. Applications must be filed by Aug. 19.

Supervising draftsman, bureau of steam engineering, Navy Department, $12.80 to $13.60 per diem. Applications must be filed before August 19.

Patent investigator, patents section, War Department, $1200 to $1800 per year. File application before August 26.

Expert patent investigator, patents section, War Department, $1800 to $2400 per year. File applications before Aug. 26.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION Tremont Temple, Boston, Sept. 30, Oct. 1-3.
AMERICAN PUBLIC HEALTH ASSOCIATION; 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

The San Francisco Engineers' Club on July 18 held a meeting of welcome to Lieut. Col. Charles B. Wing, who has returned from France with the 23d Engineers. Colonel Wing described the conditions under which the work of engineer troops was carried on at the front.

The Nickel Plate Section of the American Association of Engineers held a special meeting July 24, to adopt a constitution and by-laws. The following officers were elected: President, G. H. Tinker; vice-president, W. H. Burrage; secretary, Ernest R. Taylor; treasurer, C. R. Wright.

PERSONAL NOTES

R. L. MORRISON, professor of highway engineering, Agricultural and Mechanical College of Texas, has resigned to become associated with the Pittsburgh Testing Laboratory, as engineer of tests, department of roads and pavements, with office in Birmingham, Ala.

J. H. CONZELMAN, engineer of tests, Pittsburgh Testing Laboratory, Birmingham, Ala., has been appointed district manager of the newly established laboratory at Little Rock, Ark.

RAYMOND ROBB MARSDEN has been appointed professor of civil engineering in the Thayer School, Dart-

mouth College. Professor Marsden has been successively connected with the H. S. Ferguson Co., the Laurentide Co., Grand Mere, Que., the Riordan Pulp & Paper Co., Hawkesbury, Ont., and the Atlas Powder Co., Wilmington, Del.

LAWRENCE B. CHAPMAN, of the technical staff of the Electric Boat Co., New London, Conn., has been appointed associate professor in the new course of ship construction and marine transportation instituted last year at Lehigh University. Professor Chapman is a graduate of the Massachusetts Institute of Technology.

LIEUT. WILLIAM L. STANTON, formerly of the 304th Engineers, U. S. A., has resigned from the city engineer's staff, Flint, Mich., to become associated with the Whitehead & Kales Iron Works, Detroit.

CAPT. DONALD MACISAAC, 11th Engineers, U. S. A., has received his discharge from the service and has become associated with Smith, Hauser & MacIsaac, Inc., contractors, New York City.

W. STUART TAIT, operating vice-president, Tait Engineering Co., has resigned to become manager of engineering, Hydraulic Steel Co., Cleveland.

C. E. HOFF has been appointed county engineer, Bexar County, Texas. Mr. Hoff is a graduate of the University of Illinois.

J. G. PALMER has been appointed city engineer of Kewanee, Ill. He was previously assistant engineer, Department of State Engineer and Surveyor of New York, and United States junior engineer, Corps of Engineers, United States Army.

L. R. ASH, city manager, Wichita, Kan., has resigned to reëstablish his connection with HARRINGTON, HOWARD & ASH, Kansas City. The resignation is to take effect not later than October 1.

A. L. GOLDENSTAR has become associated with MORGAN PARK CO., Morgan Park, Duluth, Minn., as office engineer. Mr. Goldenstar was formerly connected with MORRELL & NICHOLS, architects and engineers, Minneapolis, Minn.

FAY, SPOFFORD & THORNDIKE, consulting engineers, Boston, have removed their offices to 15 Beacon St., that city.

WALLACE L. CALDWELL, district manager, Pittsburgh Testing Laboratory, Birmingham, Ala., has been appointed director of the department of roads and pavements, with headquarters at Birmingham.

G. H. NICKERSON, superintendent and engineer of the Oakdale Irrigation District, has resigned to undertake surveys for a reservoir for hydroelectric power on the Merced River, California.

F. G. EASON, senior drainage engineer of the Bureau of Public Roads, United States Department of Agriculture, has resigned to become associated with MCCRADY BROS. & CHEVES, civil engineers, Charleston, S. C. Mr. Eason will have charge of the drainage and road department.

COL. H. R. LORDLY, of Montreal, has returned from overseas, where he served with the Canadian Expeditionary Forces, and will resume his practice as consulting engineer. Colonel Lordly has been elected a Fellow of the Society of Engineers, London. He is a graduate of Cornell University and holder of the Fuertes medal.

JOHN R. FORDYCE and W. TERRY FIELD have formed a partnership under the firm name of FORDYCE & FIELD, consulting and constructing engineers, Little Rock, Ark. Major Fordyce was constructing quartermaster at Camp Pike, Arkansas. Mr. Field had been connected with the American Car & Foundry Co., Detroit, as constructing engineer.

MAJ. W. W. BURDEN, 12th Engineers, U. S. A., has been discharged from the service and will resume his former connection with the engineering corps of the City of St. Louis.

H. H. LOTTER has been appointed by the Bureau of Public Roads resident engineer of Missouri, with office in Jefferson City.

J. M. LEAMY has been appointed provincial power commissioner, Winnipeg, Man., under the act providing municipalities with electric power.

COL. HORACE S. BAKER, 111th Engineers, U. S. A., who recently returned from France, has received his discharge from the service and is now associated with FRANK D. CHASE, INC., in charge of the work for the General Motors Corporation, Janesville, Wis. Colonel Baker was graduated from Northwestern University and from the Massachusetts Institute of Technology. He was assistant city engineer of Chicago for six years.

CAPT. BEN S. MORROW has returned from overseas, where he was in charge of developing the water system at Brest. On receiving his discharge he will resume his former connection with the water bureau, Portland, Ore., taking charge of the development at Bull Run Lake.

THOMPSON & BINGER, INC., engineers and contractors, New York City and Syracuse, N. Y., specialists in the design and construction of reinforced concrete, have recently opened an office in Cleveland, Ohio, in the Citizens' Building. The Cleveland office will be in charge of J. E. GILMORE, who will have a full organization of engineering and construction experts to handle the industrial work, bridge work, and heavy construction.

LIEUT. GUY BROWN, 314th Engineers, U. S. A., has received his discharge from the service and has resumed his connection with the engineering corps of the City of St. Louis.

BRENNECKE & FAY, consulting engineers, St. Louis, have dissolved partnership. The business will be carried on in the future by E. B. FAY. Mr. Brennecke has entered a manufacturing business.

JOSEPH W. PETERS, secretary of the Engineers' Club of St. Louis, has resigned to become associated with Reeves & Skinner Machinery Co., St. Louis, as sales engineer.

CLAUDE K. SHEDD has been appointed professor of agricultural engineering and engineer in charge of tractor tests at the University of Nebraska. Professor Shedd was formerly associate professor of agricultural engineering at Iowa State College; he made brake tests at the national tractor demonstration at Cedar Rapids, Iowa, and Salina, Kan.

GEORGE F. DEWEY and F. C. DWIGGINS have formed a partnership under the firm name of DEWEY & DWIGGINS, consulting engineers, Ohio Bldg., Cairo, Ill. Mr. Dewey has been city engineer of Cairo for several years.

LLOYD W. WEED, who during the war was in charge of the cost records of the concrete ship section of the Emergency Fleet Corporation, has returned to his former position with the Turner Construction Co., New York City.

CHARLES C. HOPKINS and ARTHUR M. FIELD have become associated under the firm name of HOPKINS & FIELD, consulting engineers, Cutler Bldg., Rochester, N. Y. Mr. Hopkins was previously a consulting engineer in Rochester. Mr. Field has been city manager of Winchester, Va.

CAPT. ERNEST G. RAYNOR, 141st Engineers, U. S. A., has received his discharge from the service, and has been appointed assistant division engineer, State Engineering Department, Nebraska, with headquarters at Lincoln.

E. G. BRIGGS, sidewalk engineer, Department of Public Works, St. Paul, Minn., has resigned to become associated with GAYNOR & GAYNOR, consulting engineers, Grain Exchange, Sioux City, Iowa.

OBITUARY

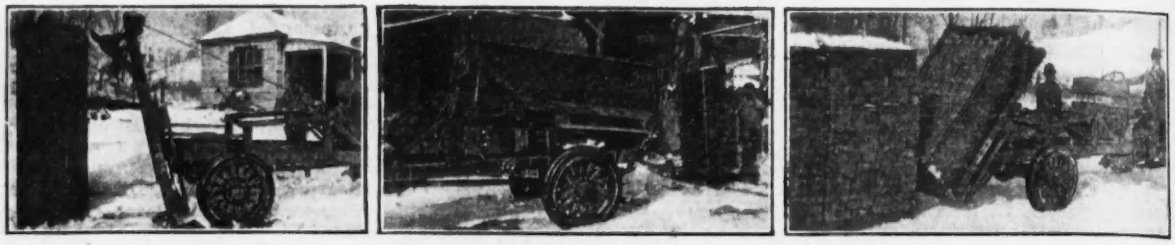
JOHN C. RODGERS died in New York City, July 26, at the age of 75. Mr. Rodgers had been engaged in the contracting business for forty years in New York; he built parts of Riverside Drive, the old subway, the West Shore and Pennsylvania Railroads, and the Niagara power tunnel.

FREDERICK SARGENT, electrical and mechanical engineer, died in Chicago, July 27. Mr. Sargent was educated at the Anderson University in Glasgow and came to the United States in 1883. He was one of the first to advocate the use of the steam turbine in electric power houses.

Demountable Truck Body for Handling Piled Material

A demountable truck body for handling piled material in such manner as to place it where needed, without rehandling, is shown in the accompanying illustration. The material being handled is paving brick, but the body can be used in the transportation of boxed goods or anything that will stay piled after the truck body is removed. It is manufactured to fit any truck. Details of the apparatus are shown at the left. It consists of an underframe with two bracket-hooks at the forward end, arranged to engage a crossbar at the upper end of the box. When the hooks have been backed under the bar, and the frame comes in contact with the box, the hoist drum just back of the driver's seat tips the box and draws it forward into the position shown in the center cut. Upon arrival at the piling point seen at right, the box is stood on end, the bottom pallet, which is left under the pile, is disconnected and the box is removed. With two or more bodies in use, so that one can be loaded while transportation is being effected with the other or others, a large saving in the time of the truck is effected.

The manufacturer of this body is the American Truck Body Co., Inc., of Martinsville, Va.



DEMOUNTABLE BODY AND UNDERFRAME FOR HANDLING PILED MATERIAL

Exports for June Break All Records

A jump in exports during June brought the total for the fiscal year which ended July 1, 1919, to more than $7,000,000,000, a new record, according to a statement by the Bureau of Foreign and Domestic Commerce. The June exports are put at $918,000,000, which exceeds the previous high records established in April of this year by more than $200,000,000. The exports for June of last year were valued at $484,000,000.

Imports for June were valued at $293,000,000, a falling off from the total of $329,000,000 recorded for May, but an increase over the $260,000,000 for June of the previous year. The total imports for the fiscal year just closed were placed at $3,096,000,000 as against $2,946,000,000 for the year of 1918.

BUSINESS NOTES

THE CAMDEN FORGE CO., Camden, N. J., has established a New York district sales office at 2 Rector St., New York City. Samuel W. Hilt has been placed in charge as manager of the new office.

THE SULLIVAN MACHINERY CO. announces the following changes in its personnel: Phillips F. Jarvis has resigned his position as sales manager for the territory controlled from the St. Louis office; Marion C. Mitchell has been appointed sales manager for the territory in Indiana and Illinois previously controlled from the St. Louis office, with temporary headquarters at Room 2006, Railway Exchange, St. Louis; Don M. Sutter, formerly manager of the El Paso office, has been appointed sales manager for the territory of western Kentucky, western Tennessee, Missouri, Arkansas, Oklahoma and Kansas, with the same address as noted above; Daniel H. Hunter has been appointed sales manager for Louisiana, Texas and the oil fields of Oklahoma and Kansas, with headquarters at Dallas, Texas.

THE ROSSENDALE - REDDAWAY BELTING & HOSE CO., Newark, N. J., has appointed E. O. Floyd as its general sales manager, to take effect Aug. 1.

THE EASTERN PAVING BRICK MANUFACTURERS' ASSOCIATION, William C. Perkins, chief engineer, has opened offices at 1019 Lincoln Bldg., Philadelphia, Penn. The formation of this association was noted in these columns some time ago.

THE CHICAGO PNEUMATIC TOOL CO., Fisher Bldg., Chicago, Ill., has appointed N. S. Thulin as special railroad representative on the staff of S. C. Sprague, manager of Western railroad sales.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE MERCHANT & EVANS CO., manufacturers of fire doors and shutters, Philadelphia, Penn.; catalog, 8¼ x 10¾ in., 24 pages, illustrated; describes fire doors, shutters and ventilators.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis.; catalog, 8 x 10½ in., 18 pages, illustrated; describes the making of large forgings.

THE McKIERNAN - TERRY DRILL CO., builders of rock drills, apparatus, pile hammers and atlas jacks, 15 Park Row, New York City; bulletin No. 25, 6 x 9 in., 19 pages, illustrated; subject of booklet is hammer drills.

THE ALLIED MACHINERY COMPANY OF AMERICA, New York City; catalog, 8½ x 11 in., 32 pages, illustrated; describes plain and universal types of machines for grinding cylindrical and conical surfaces by the use of various types of grinding machines; also, a booklet of the same size, 15 pages, illustrated, which describes the development of machine-tool production in the United States.

THE H. H. ROBERTSON CO., Pittsburgh, Penn.; engineering data booklet, 3½ x 5¼ in., loose-leaf leather binding, 20 pages of data and a memorandum section; contains data with regard to paving, of value to engineers. Additional pages will be supplied as soon as they are compiled.

THE LEGARE TEMPLET CO., 1201 Main St., Columbia, S. C.; folder, 8½ x 11 in., four pages, illustrated; describes the use of the Legare adjustable templet for highway construction.

THE CONVEYING WEIGHER CO., 90 West St., New York City; catalog, 6 x 9 in., 36 pages, illustrated; describes the use of the "Trump" measuring and mixing machine.

THE ECONOMY BODY SALES CO., distributors of "Economy" steel dump bodies, 405 Lexington Ave., New York City; folder, 8 x 11 in., four pages, illustrated; describes "Economy" steel dump and express bodies having capacities ranging from 35 to 54 cubic feet.

THE SULLIVAN MACHINERY CO., 122 S. Michigan Ave., Chicago; booklet, 5½ x 3½ in., 32 pages, illustrated; tells of the construction and use of Sullivan drills.